REPORT

MALLARD BAY: GEOTECHNICAL REPORT AND CRITICAL AREAS STUDY

SE 43rd Way and East Lake Sammamish Parkway

Issaquah, Washington

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Table of Contents

List of Tables

List of Figures

List of Exhibits

List of Appendices

1.0 INTRODUCTION

This report documents our geotechnical investigation and recommendations for the proposed Mallard Bay project in Issaquah, Washington (Figure 1). Golder completed this work for Steve Burnstead Construction Company (Burnstead).

1.1 Site and Project Description

The Mallard Bay project site is a forested, undeveloped parcel located on the northeast corner of SE 43rd Way and East Lake Sammamish Parkway (Figure 2). The lot is an irregularly shaped property that slopes down to the south and west from a high point of about 160 feet above mean sea level (AMSL) in the northeast corner to about 80 feet AMSL in the south end. Vegetation consists of deciduous and evergreen trees with a ground covering of shrubs, blackberry vines, ferns, and grasses. The site slope is dissected by a steep east-west trending ravine in the northern portion of the site. The ravine used to contain a logging road, constructed in the 1970s (Earth Consultants 1997). A small creek crosses under SE 43rd Way in a culvert and parallels the west edge of the site along SE 43rd Way flowing south. It flows across the southern portion of the site through a wetland and leaves the site at the southeast corner. There is an abandoned road entering the site near where the creek culvert is located. This road leads to a leveled pad area that was used as a storage area for a trucking company. A portion of this road where it crosses a stream has been removed. A permit (Permit Number DEM08-09) was issued in 2008 for the demolition of existing site buildings and the removal of an underground fuel storage tank. Access to the site is also possible from a City of Sammamish sewer station property adjoining the north side of the site.

The project plan includes the construction of approximately 33 residential single family lots. Access to the subdivision will be from a new road off of SE 43rd Way. Significant site grading will be needed to achieve road and lot site grades. Fill and cut retaining walls will be used to support grade changes where slopes are not suitable. Stormwater concepts include two vaults located along the access road and at the south end of the site adjacent to the wetland buffer.

1.2 Scope of Work

Our scope of services included the following tasks:

Supplemental field investigation and testing: We are aware of two geotechnical investigations at the site (Earth Consultants 1997, 1990). The 1990 investigation included five test pits on the Mallard Bay parcel. The 1997 report documents seven additional test pits and four boreholes. For this work, Golder excavated seven test pits to observe soil and groundwater conditions in the proposed area of development. In general the test pits were located in areas that have not been explored previously and target locations where retaining walls or significant cuts or fills are planned.

Complete a Preliminary Geotechnical Report and Critical Areas Study: Golder conducted engineering analysis, developed recommendations and completed a preliminary geotechnical and critical areas report (this report). The report includes information regarding and data obtained through our investigation, assessment and recommendations regarding geologic critical areas, and geotechnical recommendations for design and construction. The report includes information from previous investigations where appropriate.

2.0 GEOTECHNICAL INVESTIGATION

Previous site geotechnical site investigations were performed by Earth Consultants, Inc. (Earth Consultants 1997, 1990). These investigations consisted of excavation of several test pits and the drilling of four geotechnical boreholes. The approximate locations of these test pits and boreholes are shown in Figure 2. Copies of the historical exploration logs and laboratory test data are included in Appendices A and B, respectively.

The field investigation was completed on November 4, 2016 and consisted of the excavation of seven test pits (Table 2-1). Approximate locations of test pits are shown in Figure 2. Detailed test pit logs are presented in Appendix A. Stratigraphic contacts depicted in the test pit and boring logs represent approximate boundaries between soil types, and therefore actual transitions may be more gradual. Soil and groundwater conditions depicted are only for the specific dates and locations reported, and therefore may not necessarily be representative of other locations and times.

2.1 Test Pits

Seven test pits were excavated under the supervision of a Golder geologist to supplement existing site data. Test pit excavations were completed by Mountain View Excavating under contract to Burnstead. The locations of test pits were in areas not previously explored and where retaining walls, cuts, or fills are planned. One test pit was located next to an existing pit to use as comparison of geologic unit descriptions in Earth Consultants' 1997 report. Test pits were excavated to depths between 5.5 feet and 6.5 feet below ground surface (bgs). Test pit wall conditions were photographed and logged by a Golder geologist, and samples were placed in plastic bags for transport to Golder's soil lab for further classification and testing. Test pits were backfilled with spoils and compacted with the excavator to reduce settlement. Some settling of the test pit backfill should be expected with time.

Table 2-1: List of Test Pits

Test Pit	Depth (ft bgs)
TP-1	6.5
TP-2	6.0
TP-3	6.5
TP-4	5.5
TP-5	6.0
TP-6	6.0
TP-7	6.0

2.2 Laboratory Testing

Laboratory testing of selected soil samples was completed in Golder's Redmond, Washington laboratory to calibrate field soil descriptions and provide information for engineering design recommendations. Natural

moisture content of soils was determined in accordance with ASTM D2216. Atterberg Limits of fine-grained soils were determined in accordance with ASTM D4318. The results of the testing are summarized in Table 2-2. Laboratory testing results are presented in Appendix B.

Table 2-2: Summary of Laboratory Test Results

Exploration	Depth (ft)	Moisture Content (%)	Liquid Limit	Plasticity Index	USCS Classification
TP-1	3.5	5	-	-	-
TP-2	2	23	-	-	-
TP-3	3	30	33	14	CL
TP-4	2	25	31	16	CL
TP-4	4.2	6	-	-	-
TP-5	3	5	-	-	-
TP-6	1.5	4	-	-	-
TP-7	1.5	33	52	30	CH

3.0 SUBSURFACE CONDITIONS

This section presents the geologic setting of the site, the soil stratigraphy observed in the test pits, and groundwater conditions observed in this and previous investigations.

3.1 Geologic Setting and Mapped Geology

The project site is located within the Puget Sound Lowland region, an area whose topography and geology has been shaped by several major glacial episodes. The most recent glacial episode, the Vashon Stade of the Fraser Glaciation, is responsible for most of the present day topography and near-surface geologic conditions within the project area.

At the greatest extent ("maximum") of the last glacial period, the Puget Lobe of the Cordilleran Ice Sheet had advanced southward from British Columbia into the Puget Lowland, resulting in deposits of proglacial lacustrine sediments, advance outwash sediments, and lodgment till emplaced upon older Vashon sediments or bedrock. As the Puget Lobe retreated northward at the end of the last glacial maximum, it deposited a discontinuous veneer of recessional outwash and ablation till. The action of the glacier upon the landscape sculpted topography that is characterized by north-south trending elongate uplands and valleys, and undulating outwash planes.

Mapped geologic units within the northern portion of the project area consist of undifferentiated sedimentary deposits of the pre-Fraser glaciation, principally glacial lacustrine sediments interbedded with sand and gravel deposits. Geologic conditions encountered during Golder's field investigation are in general agreement with published geologic maps. The southern portion of the site is mapped as recent wetland deposits consisting primarily of peat and alluvium (Booth et al 2012).

3.2 Subsurface Stratigraphy

The subsurface stratigraphy at the project site consisted of topsoil overlying native deposits of glacial lacustrine sediments and/or sand and gravel deposits with the exception of TP-1 which encountered approximately 3-feet of fill overlying a buried topsoil layer which was underlain by sand and gravel. Table 3-1 summarizes the stratigraphy encountered in the boreholes. The following is a summary of geologic units encountered during Golder's explorations:

TOPSOIL: Organic rich soil of silty sand. Deposits were dark-brown in color. Generally deposits appeared loose with moist moisture content.

FILL: Fill encountered on site consists of a moderate yellowish brown silty sand and rounded gravel with a relative density of compact to dense.

GLACIAL LACUSTRINE DEPOSITS: Glacial lacustrine deposits were encountered in TP-2, TP-4, and TP-7. Deposits were thinly stratified silty sand, sandy silt, clayey silt, or silty clay, with some iron-staining. The color of the deposits ranged from pale yellowish brown to medium gray and were firm to stiff in consistency. Field moisture content determinations ranged from damp to moist.

SAND AND GRAVEL: Silty sand and rounded gravel deposits were encountered in TP-1, TP-3, TP-4, TP-5, and TP-6. Deposits were unstratified. The color of the deposits ranged from pale yellowish brown to moderate yellowish brown and were compact to dense in consistency. Field moisture content determinations ranged from damp to moist.

Table 3-1: Subsurface Stratigraphy

Exploration Number	Topsoil (ft bgs)	Fill (ft bgs)	Glacial Lacustrine Deposits (ft bgs)	Sand and Gravel Deposits (ft bgs)
TP-1	0.0 to 0.3	0.3 to 3.0		3.2 to 6.5
TP-2	0.0 to 0.5		0.5 to 6.0	
TP-3	0.0 to 0.3			0.3 to 6.5
TP-4	0.0 to 0.2		1.3 to 2.1	0.2 to 1.3 and 2.1 to 5.5
TP-5	0.0 to 0.6			0.6 to 6.0
TP-6	0.0 to 0.3			0.3 to 6.0
TP-7	0.0 to 0.3		0.3 to 6.0	

3.3 Groundwater Conditions

No groundwater was observed in the test pits excavated by Golder at the time of their excavation. Groundwater seepage was noted in two of the test pits excavated and one borehole drilled by Earth Consultants in 1996: at a depth of 2 feet in TP-13, at 3 feet and 9 feet in TP-14, and at 10 feet in borehole B-4. Groundwater seepage was also noted in two of the test pits excavated by Earth consultants in 1990: at a depth of 8 feet in TP-1 and at a depth of 5 feet in TP-2. Locations where groundwater was observed varies spatially (see Figure 2) as well as temporally.

4.0 GEOLOGIC CRITICAL AREAS

Development in geologic critical areas is regulated by Issaquah Municipal Code (IMC), Chapter 18.10 Environmental Protection. Coal mines, streams, wetlands, lakes, steep slopes, aquifer recharge areas, as well as areas subject to erosion, flooding, landslides, and seismic hazards, constitute environmentally critical areas that are of special concern to the City (Issaquah 2016). Each of these critical areas is addressed in the following sections.

4.1 Coal Mine Hazards

Underground abandoned coal mines exist in Issaquah and are listed as critical areas due to the risk of surface subsidence or collapse. The location of abandoned coal mines in Washington have been documented and summarized by the Washington State Department of Natural Resources (WDNR 1994). While there are numerous abandoned coal mines in Issaquah, there are none as far north as the Mallard Bay site along the east side of Lake Sammamish. The Mallard Bay project site does not lie within or adjacent to an area of previous underground coal mining.

4.2 Water Bodies and Aquifer Recharge Areas

Water bodies includes stream, wetlands and lakes and associated hazards such as flooding. The Mallard Bay site contains a small stream in the southwest portion of the property and associated mapped wetlands. The stream and wetland boundaries as well as associated buffers have been delineated by others and are not covered in this report. There are no lakes on the Mallard Bay site.

Critical Aquifer Recharge Areas (CARA) are areas that are determined to have a recharging effect on aquifers used as a source for potable water. The intent of the regulations is to minimize loss of recharge quantity, to maintain the protection of supply wells for public drinking water, and to prevent contamination of groundwater. CARAs are show on the City of Issaquah's Critical Aquifer Recharge Area Classification Map. A copy of the map is included as Appendix C in this report.

The CARA map illustrates that the southern lowland stream and wetlands associated with the Mallard Bay site are mapped as a Class 3 CARA or high aquifer recharge area. According to the IMC 18.10.796, Class 3 CARAs include those mapped areas outside wellhead protection areas that are identified as high aquifer recharge potential areas based on characteristics of surficial geology and soil types. The Class 3 CARA portion of the Mallard Bay site consists of the southern portion of the site that contains stream and wetland critical areas and associated buffers. The CARA regulations preclude certain land uses within Class 3 CARAs to protect against groundwater contamination. Since the mapped portion of the Class 3 CARA at Mallard Bay is already protected by critical areas delineations and buffers for streams and wetlands and will remain undeveloped, there are no additional requirements recommended to address the CARA.

4.3 Seismic Hazards

Seismic hazards are defined in the IMC as "Those areas of the City subject to severe risk of earthquake damage as a result of seismically induced settlement or soil liquefaction. These conditions may occur in areas underlain by cohesionless soils of low density usually in association with a shallow groundwater table." The soil conditions identified in explorations by Golder and others on the portion of Mallard Bay planned for development consist of medium dense to dense glacially consolidated materials. These soil materials have a low susceptibility to seismically induced liquefaction.

4.4 Erosion Hazards

The IMC defines erosion hazards as areas containing soils which, according to the United States Department of Agriculture (USDA) Soil Conservation Service, may experience severe to very severe erosion hazard. This group of soils includes, but is not limited to, the following when they occur on slopes of 15% or greater: Alderwood gravelly sandy loam (AgD), Alderwood-Kitsap (Akf), Beausite gravelly sandy loam (BeD and BeF), Kitsap silt loam (Kpd), Oval gravelly sand loam (OvD and OvF), Ragnar fine sandy loam (RaD), Ragnar-Indianola Association (RdE), and any occurrence of River Wash (Rh).

The Mallard Bay site as mapped by the USDA Soil Conservation Service (NRCS 2016) contains four soil types as follows:

EvC – Everett very gravelly sandy loam: This soil type is mapped at the very southern edge of the property along the stream channel and wetlands where no development is planned. This soil type is formed on 8 to 15% slopes and is not considered an erosion hazard per the IMC definition.

KpD – Kitsap Silt Loam - This soil type is mapped over most of the central portion of the Mallard Bay site between the ravine and abandoned logging road and the lowland at the south end of the site. The "D" in the soil type designation signifies the occurrence of this soil type on slopes of 15% or greater. This soil type is listed as an erosion hazard soil type per the IMC definition.

KpB – Kitsap Silt Loam – This soil type is mapped on the upland portion of Mallard Bay north of the shallow ravine. This soil type is not considered an erosion hazard per the IMC definition.

Ma - Mixed alluvial land – This soil type is mapped in the extreme southeastern corner of the Mallard Bay property. It is not considered an erosion hazard per the IMC definition.

The IMC development standards for sites containing erosion hazards is included in IMC 18.10.515 Development Standards paragraph B "Erosion Hazard Areas" and include eight requirements. For example, clearing on erosion hazard areas is allowed only from April 1 to November 1. Other requirements deal with timing of sediment and erosion control measures and others.

4.5 Landslide Hazards

Landslide hazard areas are defined as areas of the City subject to a severe risk of a landslide and are characterized as areas that have shown movement during the Holocene epoch or have geologic characteristics that are typical of landslide areas such as slopes greater than 40%, springs, impermeable soils interbedded with granular soils or areas undergoing rapid erosion. Not all steep slope areas (greater than 40%) meet the definition of landslide hazards areas.

Mallard Bay's steep slope hazard areas (defined in previous section) were examined in the field by a qualified geologist who looked for signs of historic slope movement, springs, or adverse geologic contacts (layered permeable and impermeable soil units, fractured clay). The steep slope areas of the site are generally small (slope heights under 30 feet) and most are associated with a shallow ravine/logging road alignment in the north half of the site. There were no visual geomorphic signs typical of landslides and no seeps on the slopes. The soil conditions included glacially consolidated silty sand and clayey silt with localized areas of sand and gravel, generally in the upland portion of the site. In our professional judgment there are no slopes on the Mallard Bay site that would qualify as landslide hazards.

4.6 Steep Slope Hazards

Steep slope hazard areas are defined in the IMC as any ground that rises at an inclination of 40% or more within a vertical elevation change of at least 10 feet. The project civil engineer (Core Design) produced a topographic exhibit that includes all the site slopes that meet the steep slope hazard definition (Exhibits A1 and A2). The delineated steep slope hazard areas on Exhibits A1 and A2 have been numbered for purposes of discussion in this report (1 to 7) starting at the south end of the site. All of the steep slopes lie along the same continuous slope that wraps around the south and west boundaries of the upland area of Mallard Bay. The steep slopes at the south end of the site range from about 70 to 80 feet elevation at the toe to 94 feet at the crest. The steep slopes along the west portion of the site and bordering the shallow ravine containing the logging road range between about 100 to 130 feet elevation with a very minor area at the head of the ravine between 140 to 150 feet elevation. Each of the slopes is described below.

4.6.1 Slope #1

This slope is located on proposed Lots #3 and 4 and consists of an arc shaped slope from 74 feet elevation to a maximum 94 feet elevation (20 feet maximum). The slope was created by mineral aggregate mining by a trucking company that occupied the large flat ground just south of Lot #5 between about 1990 and 2008. The slope is well vegetated and does not exhibit any signs of erosion of sloughing.

The Mallard Bay development plan proposes to re-grade and flatten the portions of Slope #1 between 10 and 20 feet in height as part of lot grading for Lots #3 and 4 (Figure 2). The resultant slope condition will be more stable (less steep) than the current slope condition. In accordance with IMC 18.10.580 paragraph E "Limited Exemptions", the applicant is requesting an exemption from the steep slope critical

areas for Slope #1 based on the condition that the slope was created as part of a previous, legal grading activity and is now part of the approved development proposal.

4.6.2 Slope #2

Slope #2 is located south of the planned entry road off of SE 43rd Way. It consists of a localized area of 40% slope within a larger, gentler slope located above the un-named creek (Exhibit A2). The maximum height of the 40% slope is 20 feet between 74 and 94 feet elevation. There is no development currently planned in this area and the slope will be left in its current natural forested condition. The slope is well vegetated and wooded with young second growth trees. There are no signs of erosion or slope instability.

In accordance with IMC 18.10.580 paragraph E "Limited Exemptions", the applicant is requesting a limited exemption from the steep slope critical areas for Slope #2 based on the slope height meeting the exemption criteria (up to 20 feet). Since no development is planned in the area of the slope it is our professional opinion that granting the exemption will not result in any adverse geotechnical impacts.

4.6.3 Slope #3

This segment of steep slope lies just north of Slope #2 along the same slope complex and consists of discontinuous 40% slopes ranging in height from about 6 to 18 feet (Exhibit A1). These slopes lie over the planned entrance road to Mallard Bay (see also Figure 2). The slopes connect to a segment of higher steep slopes to the north (Slope #4) but due to their discontinuous nature and relatively low height they are being described separately. The slopes are thickly vegetated and forested with young second growth trees. There are no signs of slope instability or erosion on the slopes.

Construction and grading for the planned project entrance road would eliminate nearly all of Slope #3, only a narrow band would remain on the north side of the road between the road and Slope #4. The planned entrance road would be cut into the slope and contain engineered retaining walls along the road edge where needed.

In accordance with IMC 18.10.580 paragraph E "Limited Exemptions", the applicant is requesting a limited exemption from the steep slope critical areas for Slope #3 based on the slope height meeting the exemption criteria (up to 20 feet). Nearly all of the steep slope will be removed as part of the road grading. The small portion of 40% slope remaining north of the entrance road will be unaffected and will end up being incorporated into the buffer and building setback for the adjacent Slope #4. Therefore, it is our professional opinion that granting the exemption will not result in any adverse geotechnical impacts.

4.6.4 Slope #4

Slope #4 is located along the south side of the shallow ravine and abandoned logging road in the north half of the site. The slope inclination is approximately 50% and consists of several discontinuous slope

segments with the longest continuous segments reaching 22 to 26 feet in height (Exhibit A1). The toe of the slope terminates at the edge of the abandoned logging road in the ravine floor and the crest extends to 130 to 140 foot elevation. The slopes are thickly vegetated and forested with young second growth conifers and deciduous trees. There are no signs of slope instability and no severe erosion. It appears the majority of Slope #4 is natural with the exception of some minor grading (cuts and fills) that has altered the toe of the slope during construction of the abandoned logging road.

Slope #4 is subject to the requirements of the steep slope protection requirements in the IMC (buffers and building setback) due to its inclination and maximum slope height. We recommend the City approve the following protection measures for Slope #4.

- Buffer Width = 10 feet: We recommend reducing the standard buffer of 50 feet to the minimum of 10 feet on the top, toe, and sides of Slope #4. The reduced buffer width will provide equivalent protection for the following reasons. The toe of the slope terminates in an area that will remain undeveloped. Only one building lot will be situated adjacent to the buffer along the top of the slope. The building lot will be graded flat, at the elevation of the lowest part of the adjacent slope buffer thus removing up to 10 feet of fill from the crest of slope above the steep slope critical area. By inspection, this will result in a significant improvement in the stability of Slope #4.
- Building Setback = 15 feet: We recommend including a 15 foot building setback in addition to the steep slope buffer.
- See the discussion under Slope #6 for recommendations for toe of slope grading for the residential access road retaining wall at the east end of Slope #4.

4.6.5 Slope #5

Steep slope area #5 consists of several discontinuous steep slope segments located at the upper east end of the ravine and abandoned logging road. The slope segments range in height from about 8 to 18 feet and are thickly vegetated and forested. The majority of the surface of the slopes appears natural. However, the toe of the slopes have likely been altered and flattened due to grading for the abandoned logging road (Exhibit A1). Slope #5 area is stable, with no signs of severe erosion.

The development plan would eliminate Slope #5 by filling with compacted structural fill and creating level or stepped house lots and a residential road. The west side of the road will be supported with an engineered retaining wall. The resultant slope condition will be stable.

In accordance with IMC 18.10.580 paragraph E "Limited Exemptions", the applicant is requesting a limited exemption from the steep slope critical areas for Slope #5 based on the slope height meeting the exemption criteria (up to 20 feet). No adverse impact is anticipated as a result of this exemption since all the slopes will be eliminated.

4.6.6 Slope #6

Slope #6 is located on the north side of the shallow ravine and abandoned logging road. It is the largest continuous steep slope on the Mallard Bay property with a maximum slope height of about 34 feet (Exhibit A1). The slope is thickly vegetated and forested with young second growth trees. There are no signs of slope instability, seeps or severe erosion on the slope.

Planned development near Slope #6 will include construction of a hammerhead driveway along the flat bench on the north side, above the crest of the slope. In addition, a neighborhood access road will be constructed across the east edge of the slope (Exhibit A1). The road will be supported by an engineered retaining wall. The retaining wall construction will include fill placement in the bottom of the ravine over the former logging road to reduce the height of the retaining wall. The planned filling will reduce the height of Slope #6 at the east end of the ravine at the planned road crossing to less than 20 feet. Likewise, the fill over the logging road will reduce the height of Slope #4 on the south side of the ravine to less than 20 feet adjacent to the new access road retaining wall. This will permit the construction of the residential access road and retaining wall adjacent to Slope #4 and #6 and maintain a reduced 10 foot steep slope buffer.

In accordance with IMC 18.10.580 paragraph A "Buffers" item 2, the applicant is requesting a reduction of the steep slope buffer from 50 feet to 10 feet for Slope #6. Provided the geotechnical recommendations presented in this report for controlling site drainage and stormwater runoff adjacent to slopes are followed, the reduced buffer will not reduce the level of protection provided to the development or the steep slope. The proposed site grading will not impose additional loads on the slope. The retaining wall proposed for the residential access road will be designed to support the road fill and anticipated surcharge loads and will meet required static and seismic stability design factors of safety.

4.6.7 Slope #7

Slope #7 consists of a north extension of Slope #6 that includes two discontinuous 40% steep slope segments with a maximum slope height of 12 to 14 feet (Exhibit A1). The slopes are well vegetated and do not exhibit signs of severe erosion. The toe of the slope terminates at the shoulder of SE 43rd way and it appears the slope was created all or in part during grading for construction of SE 43rd Way.

In accordance with IMC 18.10.580 paragraph E "Limited Exemptions", the applicant is requesting a limited exemption from the steep slope critical areas for Slope #5 based on both of the allowed exemption criteria, slope height less than 20 feet and slope being created by previous legal grading. The slope height for Slope #7 is less than 20 feet and no adverse impact is anticipated to result from this exemption. There will be no construction activity at the toe or sides of the slope and house lot #31 above will be graded so that no additional load will be imposed on the slope.

5.0 ENGINEERING RECOMMENDATIONS

Based on the results of our study, the proposed development is feasible from a geotechnical perspective. Conventional spread footing foundations may be used on native soils or compacted structural fill. Slab-on-grade or framed floors may be used. A variety of retaining wall types are feasible, including concrete walls, mechanically stabilized earth (MSE) walls, and rockeries. Adequate drainage of foundations, slabs, walls, and crawl spaces is essential and should be provided in the design. Once the design plans have been finalized, Golder should be given the opportunity to review the plans for consistency with our assumptions and recommendations.

The following sections present engineering design recommendations for the proposed development.

5.1 Seismic Design Criteria

Site Class and ground motion parameters for seismic design were determined in accordance with the 2015 International Building Code (ICC 2015).

5.1.1 Site Class

Site Class is based on the shear wave velocity of the upper 100 feet of soil at the site. Based on the soils encountered during Golder's field investigation and the results of previous investigation as well as geologic maps of the area, we recommend Site Class D be used for design.

5.1.2 Ground Motion Parameters

Spectral accelerations were assessed based on a point near the middle of the site, with latitude 47.5689, longitude -122.0524. Spectral accelerations based on data through 2008 were obtained using the US Geological Survey (USGS) Seismic Design Maps Tool (USGS 2014). Recommended spectral parameters are as follows:

- Mapped spectral parameters:
  - 0.2-second spectral acceleration, S_S: 1.303
  - 1.0-second spectral acceleration, S_1: 0.495
- Spectral parameters adjusted for site class:
  - 0.2-second spectral acceleration, adjusted for Site Class, S_{MS}: 1.303
  - 1.0-second spectral acceleration, adjusted for Site Class, S_{M1}: 0.745
- Design spectral parameters:
  - 0.2-second design spectral acceleration, S_{DS}: 0.869
  - 1.0-second design spectral acceleration, S_{D1}: 0.496

5.2 Foundations

Shallow spread footings appear to be feasible foundations for the proposed structures on the site. The footings will be founded on compact silty sand; compact sandy silt; compact sand and gravel; firm to stiff clayey silt; firm to stiff silty clay; or properly compacted structural fill. Footings should not be placed on loose soils, un-compacted fill, or organic soils (including topsoil). If in-situ soil conditions are not as appears in this study, the spread footings should be founded on a compacted structural fill as described later in this report.

Footings bearing on compact or firm native soils or structural fill may be designed based on the following recommendations:

- Maximum allowable bearing pressure:

  The following may be increased by 1/3 when resisting seismic or wind loads:

  - Compact silty sand, sandy silt, or sand and gravel:3.5 kips per square foot (ksf)
  - Firm to stiff clayey silt or silty clay: 2.5 ksf
- Resistance to lateral loads

  The following values may be increased by 1/3 when resisting seismic or wind loads:

  - Allowable base friction: 0.40 (includes a factor of safety of 1.5)
  - Allowable passive lateral earth pressure: 350 pounds per cubic foot (pcf) equivalent fluid density (ignore upper 1 foot of calculated passive pressure, includes a factor of safety of 2.0)
- Minimum embedment below lowest adjacent grade: 1.5 feet
- Minimum width
  - Strip footings: 1.5 feet
  - Isolated footings: 2 feet
- Settlement when subjected to maximum allowable bearing pressure: 0.5 to 1.0 inch

Perimeter footing drains are recommended for all exterior foundations, except where they are specifically designed to be inundated. Footing drains should consist of a perforated drain pipe placed at the bottom of the footing, enveloped in drain rock, and the drain rock and pipe enveloped in drainage filter fabric. Drain rock should conform to the gradation specified in Table 5-1. Footing drains should convey water under gravity flow to the storm water collection system or other suitable discharge point. Roof drainage other surface runoff should be collected and conveyed in a tight-lined system separate from the foundation drain system. Cleanouts should be provided on all drain systems. The ground surface adjacent to exterior foundations should be graded to drain away from the footing.

Table 5-1: Footing Drain Rock Gradation

Sieve Size	Percent Passing
1-1/2 inch	100 %
3/8 inch	10% – 40%
No. 4	0 – 5%
No. 200	0 – 2%

Note: Percent passing is by dry weight

5.3 Floors

Conventional slab-on-grade floors or framed floors are suitable for the site subject to the recommendations in this section.

Slab-on-grade floors can be supported on a subgrade of compact native soils or properly compacted structural fill. Slabs-on-grade should not be founded on loose soils, un-compacted fill, or organic soils (including topsoil).

We recommend slab-on-grade floors be underlain by a capillary break material, consisting of a minimum thickness of 4 inches of clean, free draining gravel, or crushed rock meeting the particle size gradation shown in Table 5-2.

Table 5-2: Capillary Break Gradation

Sieve Size	Percent Passing
1 inch	100 %
No. 4	0% – 70%
No. 10	0 – 30%
No. 100	0 – 5%
No. 200	0 – 2 %

Note: Percent passing is by dry weight

Provide drainage such that surface and subsurface water is directed away from floor subgrades or crawlspaces.

Vapor transmission from soil through floors is an important consideration in the performance of floor coverings and controlling moisture in structures. Possible moisture effects on materials placed on bare concrete floors for storage should also be considered. The identification of alternatives to prevent vapor transmission through floors is outside of our expertise. A qualified architect or building envelope consultant can make recommendations for reducing vapor transmission through floors, based on the building use and flooring specifications. Recommendations considered might include vapor barriers/retarders, concrete admixtures/coatings, drainage networks, and/or venting.

5.4 Retaining Structures

Retaining structures in the plans for the site include rockery walls and MSE walls or conventional gravity-based retaining walls.

5.4.1 Lateral Earth Pressures

Retaining walls should be designed to resist the lateral loads imposed by the retained soils and applicable surcharge loads. The following earth pressure coefficients and design parameters may be used for design of retaining walls.

Where typical passenger vehicle traffic loads will occur adjacent to the wall, a uniform vertical surcharge load of 100 pounds per square foot (psf) should be added. Additional surcharges due to adjacent foundations or heavy vehicles should be added to the design pressures as required. A uniform vertical surcharge of 250 psf is adequate for most typical construction equipment.

We recommend free-draining backfill conforming to Washington State Department of Transportation (WSDOT) 9-03.12(2) "Gravel Backfill for Walls" be used behind walls (WSDOT 2016). The walls should also include a foundation drain, as described in the "Foundations" section of this report.

Table 5-3: Design Parameters for Lateral Earth Pressures

Design Parameter	Value
Active Earth Pressure Coefficient, K_a	0.24
At-Rest Earth Pressure Coefficient, K_0	0.41
Seismic Active Earth Pressure Coefficient, K_{ae1}	0.51
Seismic Active Earth Pressure Coefficient, K_{ae2}	0.34
Allowable Passive Earth Pressure Coefficient, K_p	2.78
Allowable Seismic Passive Earth Pressure Coefficient, K_{pe}	2.59
Allowable Base Friction Coefficient, cast-in-place foundation	0.40

Notes:
1. Values assume flat ground surface at top and toe of retaining wall.
2. Values apply to backfill soils meeting WSDOT Standard Specification 9-03.12(2) "Gravel Backfill for Walls" (WSDOT 2016).
3. Use K_a for the design of permanent cantilever walls free to rotate about the top.
4. Use K_{ae1} for the design of permanent walls that cannot deflect during design earthquake (seismic coefficient $k_h = 0.35$).
5. Use K_{ae2} for the design of permanent walls where permanent deflections of 1 inch resulting from the design earthquake are acceptable (seismic coefficient $k_h = 0.17$).
6. Values for passive earth pressure coefficients (K_p and K_{pe}) include factors of safety of 2.0 and 1.5, respectively.
7. Value for base friction coefficient includes a factor of safety of 1.5, and may be increased by 1/3 when resisting wind or seismic loads.

5.4.2 Rock Walls

Rock walls (rockeries) may be appropriate to support cuts and fills associated with site grading. We do not recommend rockeries in areas where the ground at the top or bottom of the rockery will be sloped steeper

than about 6H:1V (Horizontal:Vertical) or in areas where the rockery would be required to support vehicle traffic or other significant surcharge loads. Rockeries should be designed in accordance with the following recommendations.

Drainage: Proper drainage is critical for retaining walls. Free-draining fill should be included immediately behind the rock fascia to ensure proper drainage. This free-draining fill should be shot rock or quarry spalls conforming to the requirements of WSDOT section 9-13.7(2) "Backfill for Rock Wall" (WSDOT 2016). A foundation drain, as described in the "Foundations" section of this report, should also be provided.

Geosynthetic Filter Fabric: A geosynthetic filter should be installed between the free-draining fill and the retained material to prevent the retained material from washing out. Filter fabric should conform to WSDOT Section 9-33 "Construction Geosynthetic" (WSDOT 2016).

Rock Facing: All rockery fascia elements should conform to WSDOT Section 9-13.7(1) "Rock for Rock Walls and Chinking Material" (WSDOT 2016). Rock elements should be sound, un-weathered, weathering resistant, angular ledge rock. The longest dimension of any individual rock should not exceed three times the rock's shortest dimension. Suitability of rock should be determined by a qualified engineer, and we recommend using rock from a quarry that has documentation of test data indicating the rock is durable. The face of the rockery wall should be battered to 1H:6V or flatter.

Height: Cut rockery walls can be as tall as 6 to 8 feet without reinforcement. Fill walls can be as tall as 4-feet high without soil reinforcement. Fill should be placed and compacted beyond the desired face of the rock wall and then cut prior to placement of rock fascia.

5.4.3 Mechanically Stabilized Earth Walls

MSE walls may be appropriate as retaining structures for the proposed development provided the following recommendations are followed.

MSE Reinforced Fill: We recommend that a high quality, clean, well-graded sand and gravel fill such as material meeting WSDOT 9-03.14(4) "Gravel Borrow for Structural Earth Wall" (WSDOT 2016) be used. The maximum fines content allowed by that specification is 7%. A material with up to 15% fines content may be used if additional drainage features are provided as described below.

Drainage: MSE walls can perform poorly if the backfill behind the wall and/or in the reinforcement zone becomes saturated. Thus, it is essential to use free-draining fill within the zone of reinforcement. If finer-grained fill is considered, a chimney drain should be used behind the

reinforced zone and a sand blanket should be used beneath the reinforced zone to intercept and drain any seepage. A drainage layer, usually consisting of clean gravel or crushed rock meeting filter criteria, should also be included immediately behind the MSE wall face. The wall designer should be consulted if material changes occur, so that appropriate drainage provisions are made.

Table 5-4: Soil Parameters for MSE Wall Design

Soil Properties	Reinforced Soil	Retained Soil	Foundation Soil
Unit Weight (pcf)	125	125	125
Friction Angle (deg)	34	32	32
Cohesion (psf)	0	0	0

5.5 Permanent Slopes

For preliminary design purposes we recommend that long-term permanent cut slopes should be 2H:1V or flatter assuming proper drainage and erosion control. In our experience, 2H:1V and steeper slopes are significantly more likely to experience erosion or sloughing during the first winter season, until vegetation is well established. Aggressive erosion control measures, including plastic sheeting, are sometimes needed to prevent significant slope damage. In general, 3H:1V slopes or gentler are preferred for ease of maintenance and application of landscaping.

6.0 CONSTRUCTION RECOMMENDATIONS

Geotechnical-related site construction activities will consist of stripping and grubbing, temporary excavations, subgrade and foundation preparation, and placement and compaction of structural fill. Based on the observed soil conditions, conventional earthwork equipment can be used for excavation, fill placement, grading, and compaction. Most of the on-site soil is suitable for re-use, depending on fines content, moisture, and intended purpose. Silty soils are not suitable for use where free-draining materials are required, and they can become unusable during wet season construction.

No groundwater was observed in Golder's investigation. However, previous studies have encountered groundwater as shallow as 3 feet. The contractor should be prepared to control areas of seepage that could occur in excavations.

Erosion control and surface water drainage should be included in construction plans. A qualified geotechnical firm representative should monitor critical aspects of construction.

6.1 Erosion Control and Construction Drainage

Erosion control for the site will include the Best Management Practices (BMPs) incorporated in the civil design drawings and may incorporate the following recommendations:

- Limit exposed cut slopes.
- Route surface water through temporary drainage channels around and away from exposed slopes.
- Use silt fences, straw, and temporary sedimentation ponds to collect and hold eroded material on the site.
- Seeding or planting vegetation on exposed areas where work is completed and no buildings are proposed.
- Retaining existing vegetation to the greatest possible extent.

Even during dry weather, Golder recommends site drainage measures be incorporated into the project construction. Construction of a detention pond or vault, either temporary or permanent, is recommended early in development so it can be used for water and sediment control during construction of the up-slope portions of the site.

Surface runoff can be controlled during construction by careful grading practices. We recommend that the contractor sequence excavations so as to provide constant positive surface drainage for rainwater and any groundwater seepage that may be encountered. This will require grading slopes, and constructing temporary ditches, sumps, and/or berms. All collected water should be directed, under control, to a positive and permanent discharge system such as the storm detention pond or vault. Construction stormwater

facilities should be designed to handle higher sediment content compared to the post-development condition. The site should be graded at all times to facilitate drainage and minimize the ponding of water.

6.2 Site Preparation

Site preparation should include removal of existing structures, utilities, vegetation, root mass, organic soils, and any other deleterious materials from areas where buildings, pavements, or structural fill will be placed. Organic soils (including topsoil) may be used as landscaping fill. The thickness of topsoil observed in Golder's investigation and investigations by others ranged from 0 to 1 foot. Areas of deeper organics should be anticipated, such as where tree root balls and stumps and poorly drained areas are present. These deep organics, if present within areas to be developed, should likewise be removed by excavation and backfilled with structural fill. Any uncontrolled fill and underlying organics and topsoil should also be removed from areas where building, pavements, or structural fill will be placed.

6.3 Slopes and Temporary Excavations

Slopes should be protected from erosion and instability. Practices to protect the slopes include maintaining existing vegetation on the slope, establishment of vegetation on new slopes, temporary placement of plastic sheeting over the slope face, placement of berms or drains to divert storm water from flowing down the slope face, and limiting the amount of exposed slope-face at a given time by construction scheduling.

Safe temporary excavations are the responsibility of the contractor and depend on the actual site conditions at the time of construction. Temporary excavations should comply with all Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) standards. Based on observed conditions, walls of temporary excavations should be no steeper than 1.5H:1V where groundwater seepage is not encountered. If groundwater seepage is encountered, walls should then be sloped at 2H:1V or flatter to prevent caving or sloughing. If these slopes cannot be achieved, temporary shoring may need to be installed. The contractor should employ appropriate temporary shoring in trenches with vertical walls.

In the event that groundwater seepage is encountered during excavation, the contractor should install temporary drainage measures to protect the cut face and prevent degradation of the excavation area until permanent drainage measures can be constructed.

6.4 Subgrade and Foundation Preparation

It is expected that foundations will be founded on compact to dense silty sand, sandy silt, or sand and gravel. If the soil exposed during construction is loose or otherwise un-suitable (e.g., too wet, peat) it should be conditioned, if practical, or removed and replaced with compacted structural fill.

If soil moisture conditions allow, after exposing the subgrade for foundations or structural fill, we recommend proof-rolling the subgrade with a loaded dump truck or other heavy wheeled vehicle (e.g. wheel loader). If

the subgrade is wet or it is not feasible to access the subgrade with a heavy wheeled vehicle, we do not recommend performing a proof roll. Instead we recommend that the subgrade conditions be observed by the geotechnical engineer prior to structural fill placement.

Where fill will be placed adjacent to an existing slope, steps should be excavated into the existing slope to help "key" the new fill into the slope.

Based on our visual examination of soil samples and our experience, the silty soils encountered onsite can become loosened and easily disturbed under the influence of surface water and construction equipment. The contractor will have to implement suitable procedures to protect the subgrade, such as excavating without tracking on the native soils, use of a crushed rock or gravel-working mat, dewatering, soil admixing, geotextiles, or other suitable procedures during construction.

Native competent subgrade that becomes loosened by the contractor's operation and wet and unsuitable soils should be over-excavated and replaced with a suitable structural fill, or the soil admixed with a moisture reducing agent or cement treated base (CTB). The footing excavations should be free of any loose, soft, or disturbed material; and of water prior to placement of reinforcing bars and concrete.

6.5 Fill Materials, Placement and Compaction

Structural fill, including fill supporting structures and pavements, and fill behind retaining walls (and within MSE walls) is the primary focus of this section. Non-structural fill or fill in landscaped areas should also be compacted in lift thicknesses of 12 inches or thinner and should be firmly compacted.

6.5.1 Structural Fill Materials

Structural fill should be free of all debris and organic matter. Structural fill should be near the optimum moisture content and otherwise capable of being compacted to the required specifications for the particular use. Typical structural fill materials include clean sand and gravel; well-graded mixtures of sand and gravel (commonly called "gravel borrow" or "pit-run"); mixtures of silt, sand, and gravel; crushed rock; quarry spalls; and controlled-density fill (CDF). If on-site soils do not meet the criteria for structural fill, or cannot be reworked to a suitable condition, we recommend using imported granular fill consisting of clean, well-graded sand and gravel, such as WSDOT 9-03.14(1) "Gravel Borrow" (WSDOT 2016). Other materials may be used with the approval of the engineer. Structural fill imported for use during wet weather should be free-draining.

Structural fill that must be free draining, such as retaining wall backfill, should be clean sand and/or gravel with less than 5% content passing the No. 200 sieve. For imported free-draining structural fill for use as wall backfill, we recommend using WSDOT 9-03.12(2) "Gravel Backfill for Walls" (WSDOT 2016). For imported free-draining structural fill for use other than as wall backfill, we recommend WSDOT 9-03.14(1)

"Gravel Borrow" (WSDOT 2016) except with less than 5% content passing the No. 200 sieve. Other materials may be used with the approval of the engineer.

6.5.2 Structural Fill Placement

Structural fill should be placed in horizontal lifts not exceeding 8 inches in thickness before compaction. Each lift should be thoroughly compacted with a mechanical compactor. Structural fill supporting footings should extend laterally outside of the footing base at a 1H:1V or flatter inclination projected down and away from the bottom edges of the footing. In areas of thick structural fill, this requirement may be relaxed with the approval of the engineer.

6.5.3 Structural Fill Compaction

Using the maximum dry density determined by ASTM D1557 ("modified proctor") as a standard, we recommend that structural fill should be compacted to the minimum density presented in Table 6-1. If multiple different compaction requirements apply to an area of structural fill, the compaction should meet the most stringent applicable requirement.

Table 6-1: Compaction Criteria

Fill Application	% Minimum Compaction
Building pad	95
Footing subgrade or bearing pad	95
Slab-on-grade floor subgrade and subbase	95
Retaining wall footing subgrade	95
Concrete slab subgrades	95
Asphalt pavement base and subbase	95
Asphalt pavement subgrade	95
Retaining wall backfill	90
Footing and stem wall backfill	90

6.5.4 Structural Fill Subgrade Verification and Compaction Testing

Structural fill should be placed on firm, yielding subgrade prepared in accordance with the recommendations in this report. The condition of all subgrade should be verified by the geotechnical engineer before filling or construction begins. Fill compaction should be verified by means of in-place density tests performed per ASTM D6938 (or appropriate alternative when ASTM D6938 is not suitable for the fill material) during fill placement so that compaction may be evaluated as earthwork progresses.

Pavement and foundation subgrade should be maintained in a well-compacted state and protected from degradation prior to paving or placing concrete. Protection measures may include restricted traffic,

perimeter drain ditches, or placement of a protective gravel layer on the subgrade. Disturbed or wet areas in the subgrade should be removed and replaced by suitably compacted structural fill.

6.6 Re-Use of On-Site Soils

Two main types of soil were identified during the excavation. The first type is sand and gravel deposits with varying fines content. The second type is glacial lacustrine deposits of silty sand, sandy silt, clayey silt, and silty clay. The sand and gravel soils are suitable for re-use as structural fill. They are generally not suitable for use as free-draining structural fill. The silty sand and sandy silt glacial lacustrine deposits may be suitable for re-use as structural fill if the moisture content is close to optimum for proper compaction. The silty sand and sandy silt glacial lacustrine deposits will generally not be suitable for re-use as structural fill during wet season or wet weather conditions. Clayey silt or silty clay glacial lacustrine deposits are not suitable for re-use as structural fill.

6.7 Wet Weather Construction

Although feasible, earthwork construction during wet weather or the rainy season will significantly increase costs associated with off-site disposal of unsuitable excavated soils; effort to control surface water; and subgrade disturbance and need for soil admixtures, geotextiles, or rock working mats.

For fill placement during wet-weather site work, we recommend free-draining soils as described previously in this report.

6.8 Geotechnical Construction Monitoring

We recommend that a qualified geotechnical-engineering firm is on-site during critical geotechnical aspects of the project. This would include observation of excavation; footing, slab, wall, and pavement subgrade preparation; placement of wall and footing drains; subgrade in areas where structural fill will be placed; and placement and compaction of structural fill. As required by the International Building Code (ICC 2015) the geotechnical engineer of record shall perform the special inspection.

7.0 USE OF THIS REPORT

This report has been prepared exclusively for the use of Steve Burnstead Construction Company and their consultants for the project described.

The conclusions and recommendations presented in this report are based on the explorations and observations completed for this study, conversations regarding the existing site conditions, and our understanding of the planned project. The conclusions are not intended nor should they be construed to represent a warranty regarding the project, but they are included to assist in the planning and design process.

Judgment has been applied in interpreting and presenting the results. Variations in subsurface conditions outside the exploration locations are common in glacial environments, such as those encountered at the site. Actual conditions encountered during construction might be different from those observed in the explorations. When the site project plans are finalized, we recommend that Golder be given the opportunity to review the plans and specifications to verify that they are in accordance with the conditions described in this report.

The explorations were advanced and logged in general accordance with locally accepted geotechnical engineering practice, subject to the time limits, and financial and physical constraints applicable to the services for this project, to provide information for the areas explored. There are possible variations in the subsurface conditions between the borehole locations and variations over time.

The professional services retained for this project include only geotechnical aspects of the subsurface conditions at the site. Environmental services were not included in the scope of work. The presence or implications of possible surface and/or subsurface contamination resulting from previous site activities and/or resulting from the introduction of materials from off-site sources not addressed in this report.

8.0 CLOSING

We appreciate the opportunity to work on this project, and expect that this report meets your needs. If you have questions, comments, or require further information, please contact us.

GOLDER ASSOCIATES INC.

STEVEN VAN SHAAR STATE OF WASHINGTON 42839 REGISTERED PROFESSIONAL ENGINEER

12/15/16

Steven Van Shaar, PE
Senior Project Engineer

State of Washington Engineering Geologist 943 Licensed Geologist

James Gerard Johnson

James G. Johnson, LEG
Principal Geologist

SRV/JGJ/ks

9.0 REFERENCES

ASTM International. D1557. Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.

ASTM. D2216. Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

ASTM. D4318. Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

ASTM. D6938. Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

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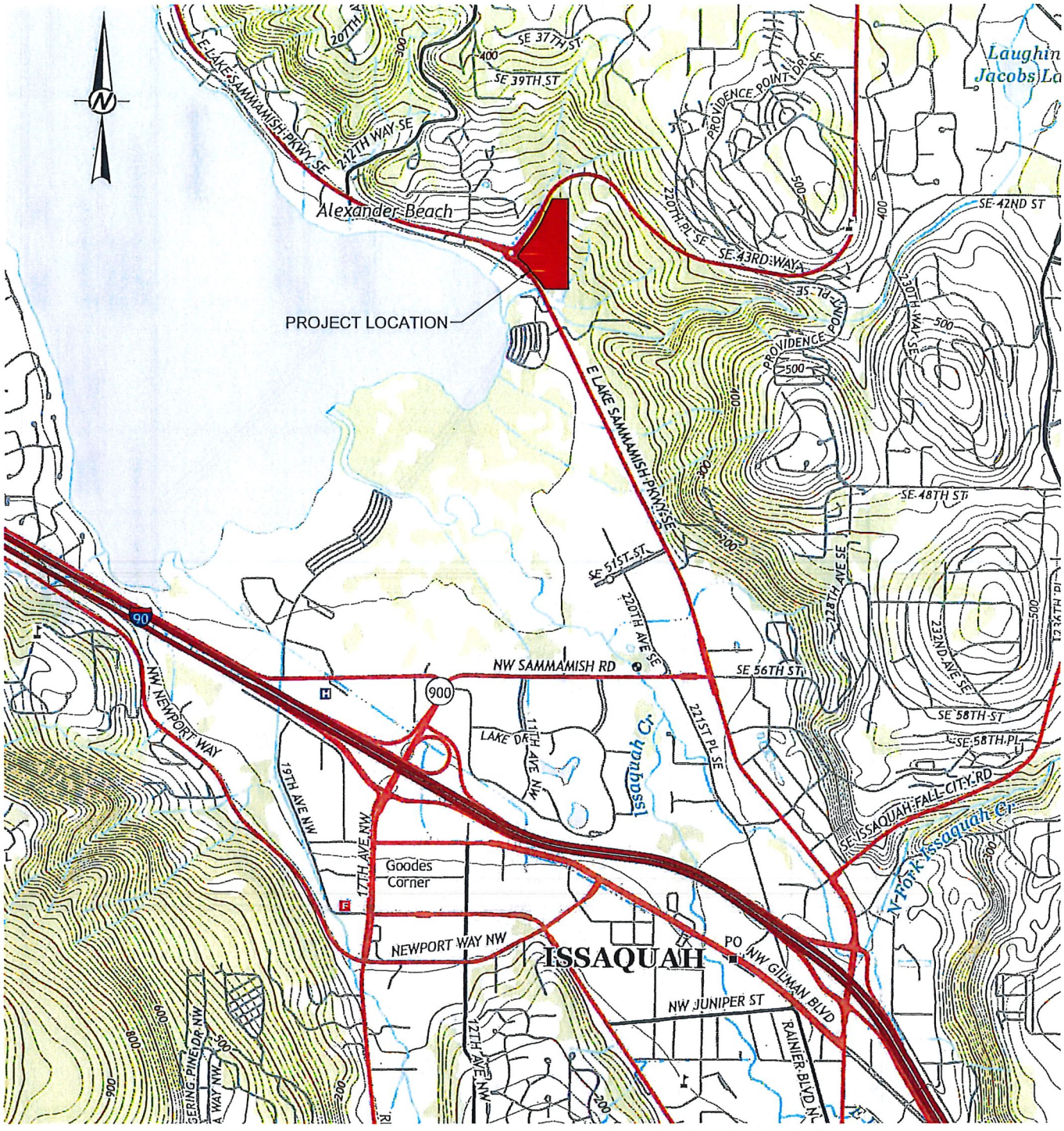
FIGURES



REFERENCE(S)
TOPOGRAPHIC BASE MAP PROVIDED BY USGS, DELIVERED IN PDF FORMAT ON 2016-12-07.

0 1000 2000
1" = 2000' FEET

CLIENT
BURNSTEAD CONSTRUCTION COMPANY

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-12-15
DESIGNED	SV
PREPARED	REDMOND
REVIEWED	SV
APPROVED	JGJ

PROJECT
GEOTECHNICAL INVESTIGATION
MALLARD BAY
ISSAQUAH, WA

TITLE
VICINITY MAP

PROJECT NO.	PHASE	REV.	FIGURE
1667207	100	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

1 in

Last Edited By: trybar Date: 2016-12-09 Time: 2:21:59 PM | Printed By: TRybar Date: 2016-12-15 Time: 10:23:28 AM
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LEGEND

- PROPERTY BOUNDARY
- TP-1 GOLDER ASSOCIATES TEST PIT - 2016
- TP-11 EARTH CONSULTANTS TEST PIT - 1996
- B-1 EARTH CONSULTANTS BOREHOLE - 1996
- TP-1 EARTH CONSULTANTS TEST PIT - 1990
- EXISTING EASEMENT BOUNDARIES
- EXISTING CREEK

REFERENCE(S)

1. BASE MAP, INCLUDING TOPOGRAPHY, EXISTING AND PROPOSED FEATURES, PROVIDED BY CORE DESIGN INC. DELIVERED IN DWG FORMAT ON DECEMBER 5, 2016.

NOTE(S)

1. LOCATIONS OF HISTORICAL EXPLORATIONS ARE APPROXIMATE. REFER TO ORIGINAL REPORT FOR MORE INFORMATION.

0 50 100
1" = 50' FEET

CLIENT
BURNSTEAD CONSTRUCTION COMPANY

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-12-15
DESIGNED	SV
PREPARED	REDMOND
REVIEWED	SV
APPROVED	JGJ

PROJECT
GEOTECHNICAL INVESTIGATION
MALLARD BAY
ISSAQUAH, WA

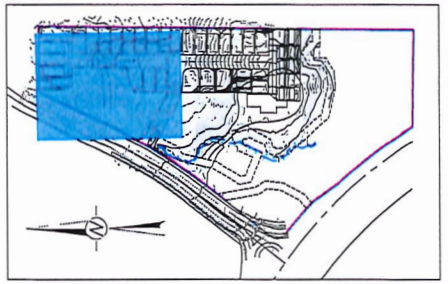
TITLE
EXPLORATION PLAN

PROJECT NO.	PHASE	REV.	FIGURE
1667207	100	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

EXHIBITS

KEY MAP



LEGEND

- SLOPE AREAS (SEE DISCUSSION IN REPORT)
- SLOPES STEEPER THAN 40%
- PROPOSED STRUCTURAL FILL AREA
- PROPERTY BOUNDARY
- LIMIT OF DESIGNATED SLOPE AREAS
- EXISTING GRADE
- PROPOSED GRADE

REFERENCE(S)

1. BASE MAP, INCLUDING TOPOGRAPHY, EXISTING AND PROPOSED FEATURES, PROVIDED BY CORE DESIGN INC, DELIVERED IN DWG FORMAT ON DECEMBER 5, 2016.
2. STEEP SLOPES DWG PROVIDED BY CORE DESIGN INC, DELIVERED IN DWG FORMAT ON DECEMBER 6, 2016.

0 20 40
1" = 20' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2016-12-15	ISSUED FOR REVIEW	SV	REDMOND	SV	JGJ

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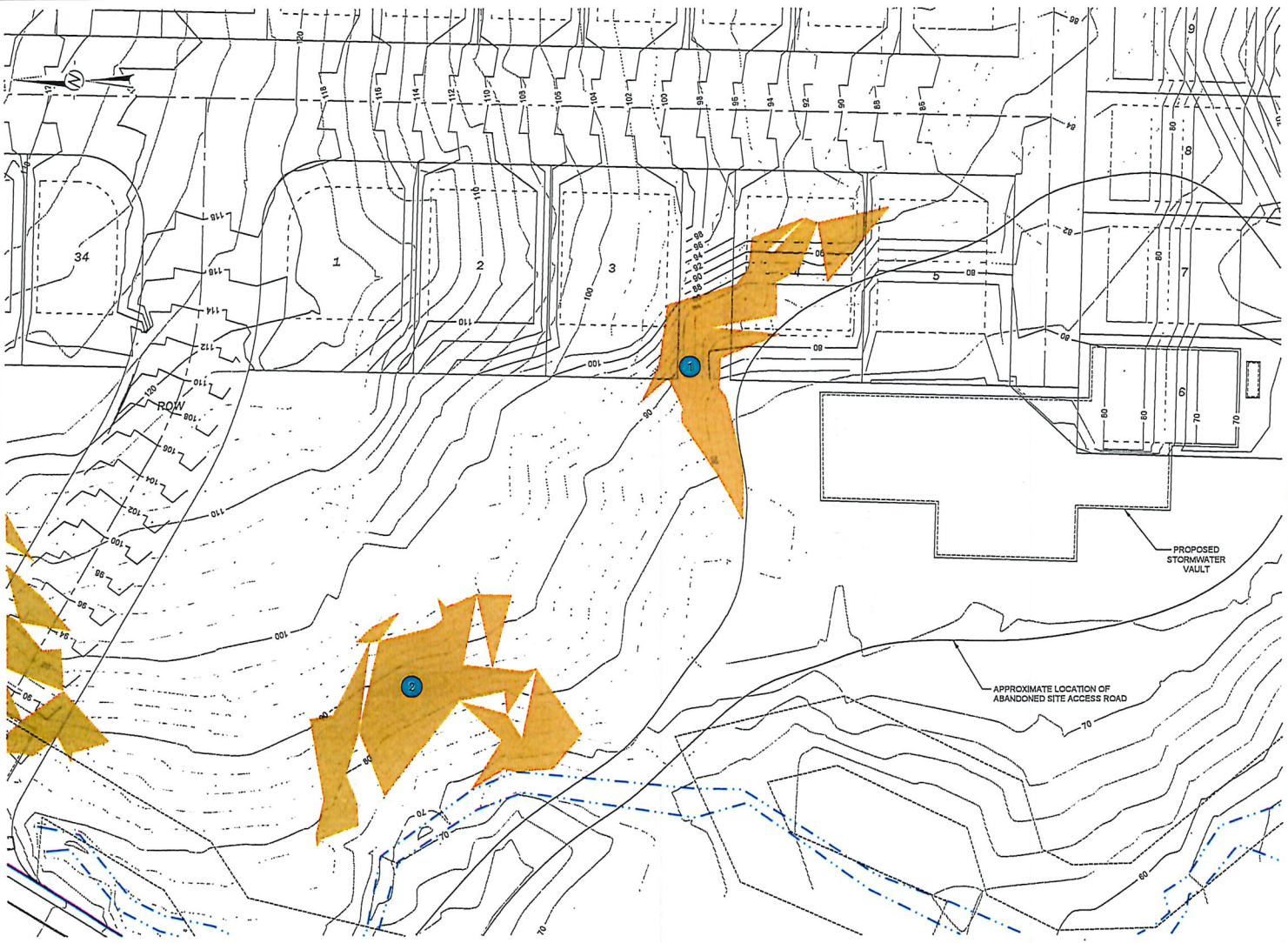
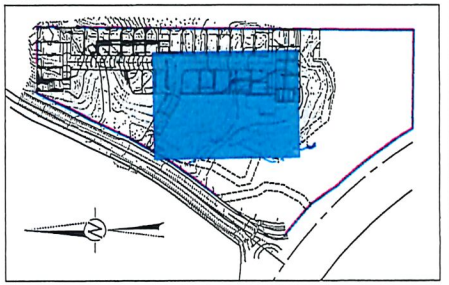
PROJECT
GEOTECHNICAL INVESTIGATION
MALLARD BAY
ISSAQUAH, WA

TITLE
STEEP SLOPE AREAS (NORTH)

PROJECT NO.	PHASE	REV.	EXHIBIT
1667207	100	0	A1



KEY MAP



LEGEND

- 1 — SLOPE AREAS (SEE DISCUSSION IN REPORT)
- SLOPES STEEPER THAN 40%
- PROPERTY BOUNDARY
- EXISTING CREEK
- 100 — EXISTING GRADE
- 120 — PROPOSED GRADE

REFERENCE(S)

1. BASE MAP, INCLUDING TOPOGRAPHY, EXISTING AND PROPOSED FEATURES, PROVIDED BY CORE DESIGN INC. DELIVERED IN DWG FORMAT ON DECEMBER 5, 2016.
2. STEEP SLOPES DWG PROVIDED BY CORE DESIGN INC. DELIVERED IN DWG FORMAT ON DECEMBER 6, 2016.

0 20 40
1" = 20' FEET

REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED
0	2016-12-15	ISSUED FOR REVIEW	SV	REDMOND	SV	JGJ

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PROJECT.
GEOTECHNICAL INVESTIGATION
MALLARD BAY
ISSAQUAH, WA

TITLE
STEEP SLOPE AREAS (SOUTH)

PROJECT NO.	PHASE	REV.	EXHIBIT
1667207	100	0	A2

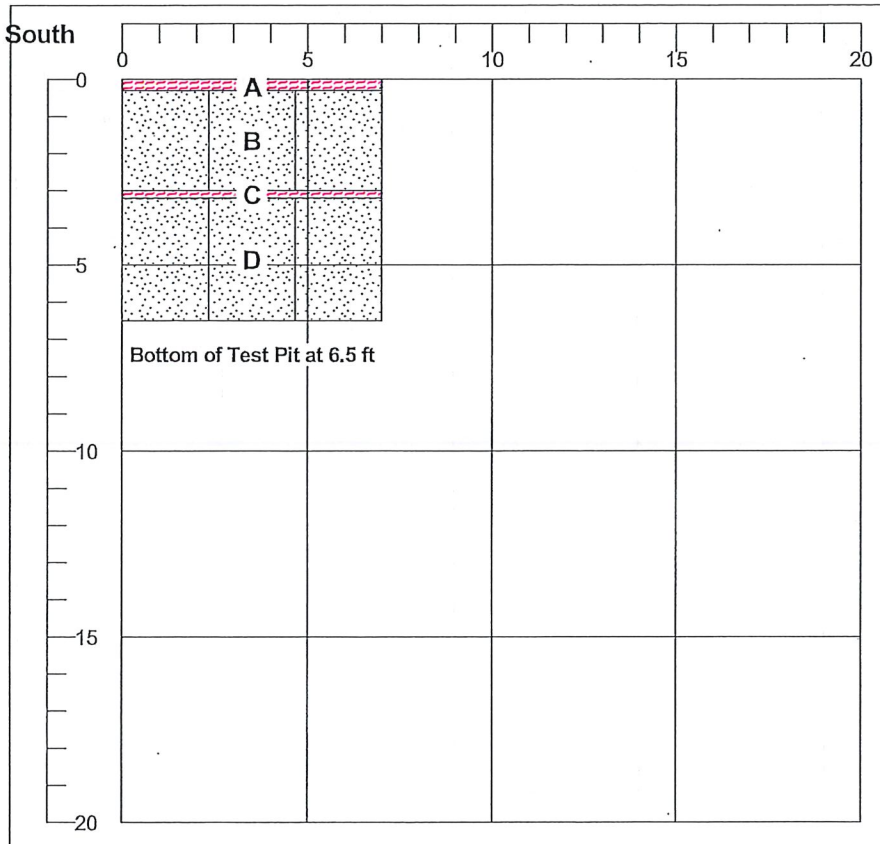
IF THIS LEGAL SHEET DOES NOT MEASURE 11" x 17" THEN IT HAS BEEN REDUCED FROM ITS ORIGINAL SIZE

APPENDIX A
EXPLORATION LOGS

LOG OF TEST PIT TP-1

Golder Associates

Temp _____ °F Weather Clear | Engineer AGM | Operator Ted
Equipment CAT 303GR | Contractor Mountain View | Date 11/4/2016
Elevation _____ | Datum Geodetic | Job 1667207
Location _____



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.3 ft: TOPSOIL

B 0.3 - 3.0 ft: SM, fine to coarse SAND and fine to coarse, rounded GRAVEL, little silt, moist, moderate yellowish brown, compact to dense

C 3.0 - 3.2 ft: BURIED TOPSOIL

D 3.2 - 6.5 ft: SM, fine to coarse SAND and fine to coarse, rounded GRAVEL, little silt, moist, moderate yellowish brown, compact to dense

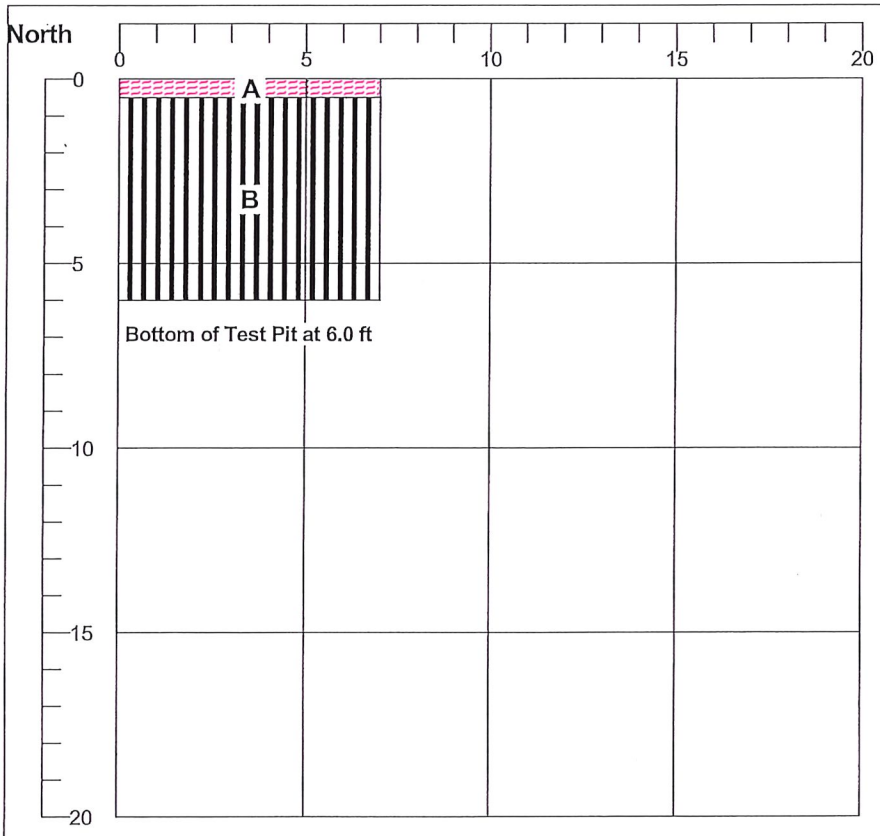
TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

LOG OF TEST PIT TP-2

Golder Associates

Temp _____ °F Weather Clear | Engineer AGM | Operator Ted
Equipment CAT 303GR | Contractor Mountain View | Date 11/4/2016
Elevation _____ | Datum Geodetic | Job 1667207
Location _____



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.5 ft: TOPSOIL

B 0.5 - 6.0 ft: MH, CLAYEY SILT, little fine sand, thinly bedded, iron stained, pale yellowish brown, firm to stiff

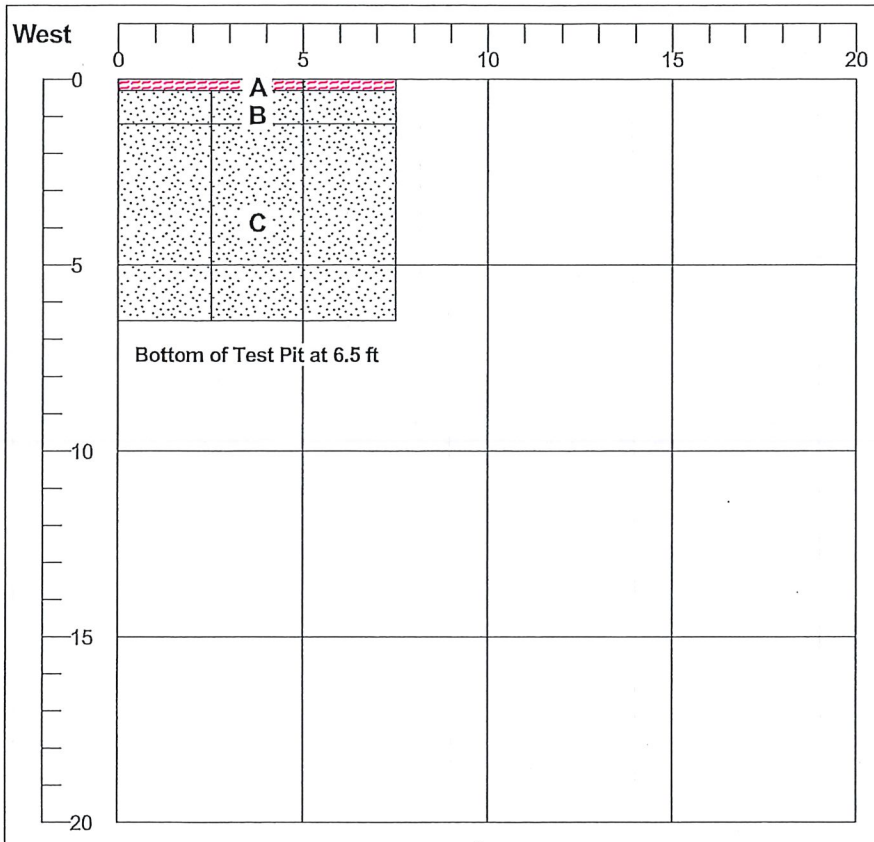
TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

LOG OF TEST PIT TP-3

Golder Associates

Temp_____°F Weather_Clear_____ Engineer_AGM_____ Operator_Ted_____
Equipment_CAT 303GR_____ Contractor_Mountain View_____ Date_11/4/2016_____
Elevation_____ Datum_Geodetic_____ Job_1667207_____
Location_____



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.3 ft: TOPSOIL

B 0.3 - 1.2 ft: SM, silty, fine to medium SAND, little fine to coarse, rounded gravel, moist, pale yellowish brown, compact

C 1.2 - 6.5 ft: SM, clayey silty, fine to coarse SAND, little fine to coarse, rounded gravel, moist to wet, medium dark gray, iron stained, pieces of charcoal, compact

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

LOG OF TEST PIT TP-4

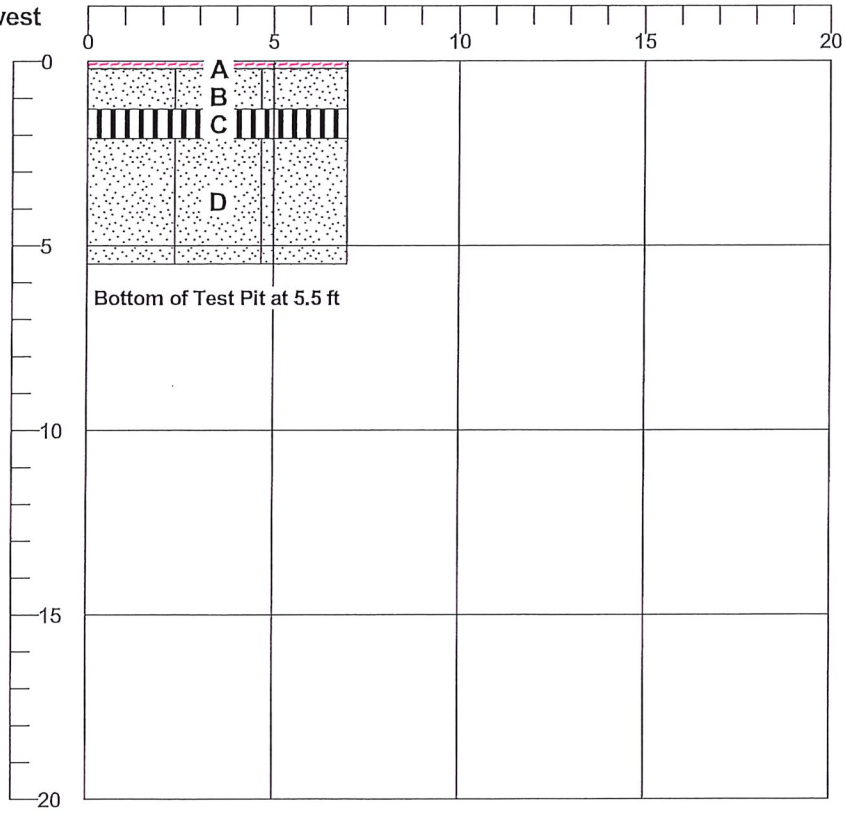
Golder Associates

Temp _____ °F Weather Clear
Equipment CAT 303GR
Elevation _____
Location _____

Engineer AGM
Contractor Mountain View
Datum Geodetic

Operator Ted
Date 11/4/2016
Job 1667207

Southwest



Northeast

SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.2 ft: TOPSOIL

B 0.2 - 1.3 ft: SM, silty, fine to coarse SAND, some fine to coarse, rounded gravel, moderate yellowish brown, compact

C 1.3 - 2.1 ft: MH, CLAYEY SILT, little fine to medium sand, thinnly bedded, pale yellowish brown, firm

D 2.1 - 5.5 ft: SM, fine to coarse SAND and fine to coarse rounded GRAVEL, little silt, pale yellowish brown, moist, very dense

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)

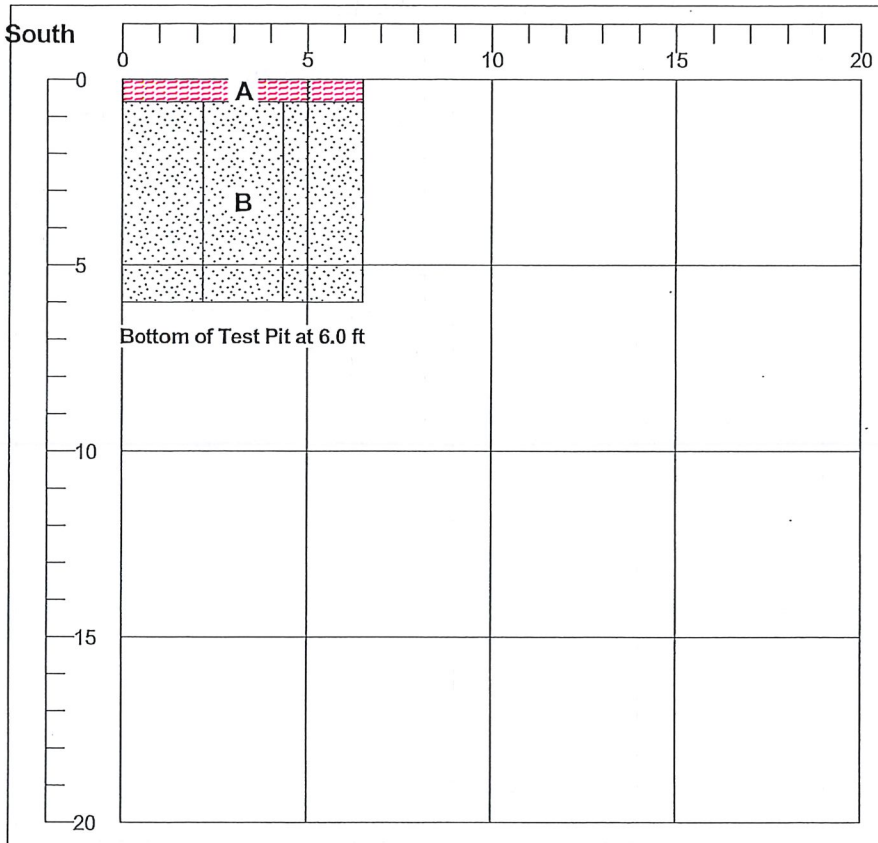
SPECIAL NOTES:

LOG OF TEST PIT 1667207_MALLARD_BAY_TEST_PITS.GPJ GLDR_WA.GDT 11/5/16

LOG OF TEST PIT TP-5

Golder Associates

Temp _____ °F Weather Clear | Engineer AGM | Operator Ted
Equipment CAT 303GR | Contractor Mountain View | Date 11/4/2016
Elevation _____ | Datum Geodetic | Job 1667207
Location _____



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.6 ft: TOPSOIL

B 0.6 - 6.0 ft: SM, fine to coarse SAND and fine to coarse, rounded GRAVEL, little silt, moderate yellowish brown, dense

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

LOG OF TEST PIT TP-6

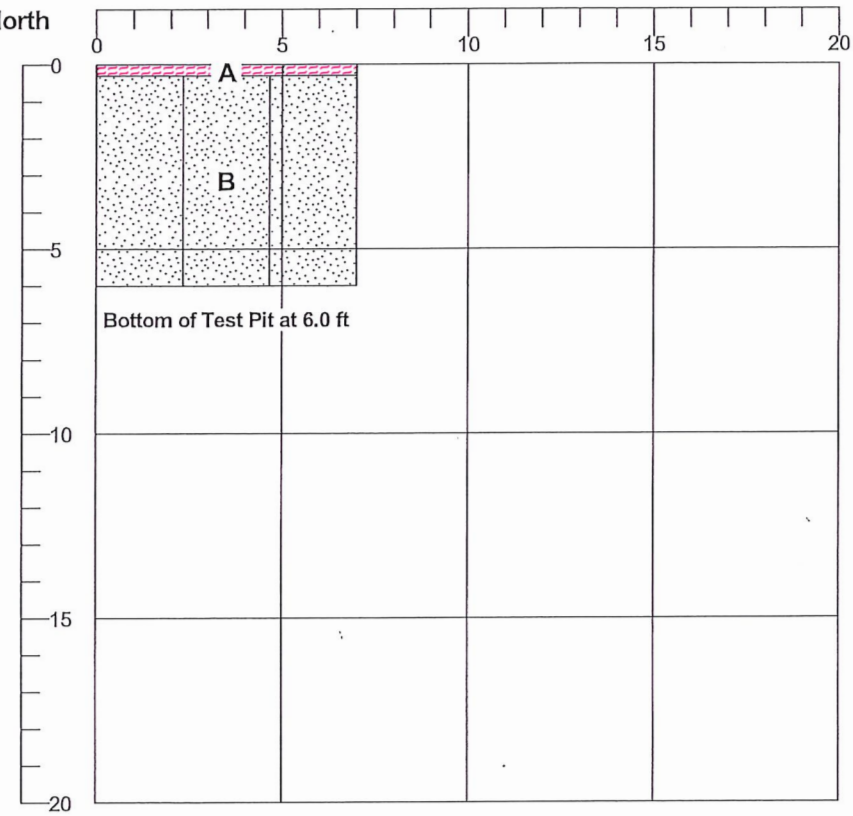
Golder Associates

Temp _____ °F Weather Clear
Equipment CAT 303GR
Elevation _____
Location _____

Engineer AGM
Contractor Mountain View
Datum Geodetic

Operator Ted
Date 11/4/2016
Job 1667207

North



South

SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)

LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.3 ft: TOPSOIL

B 0.3 - 6.0 ft: SM, fine to coarse SAND and fine to coarse, rounded GRAVEL, little silt, moderate yellowish brown, dense

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:

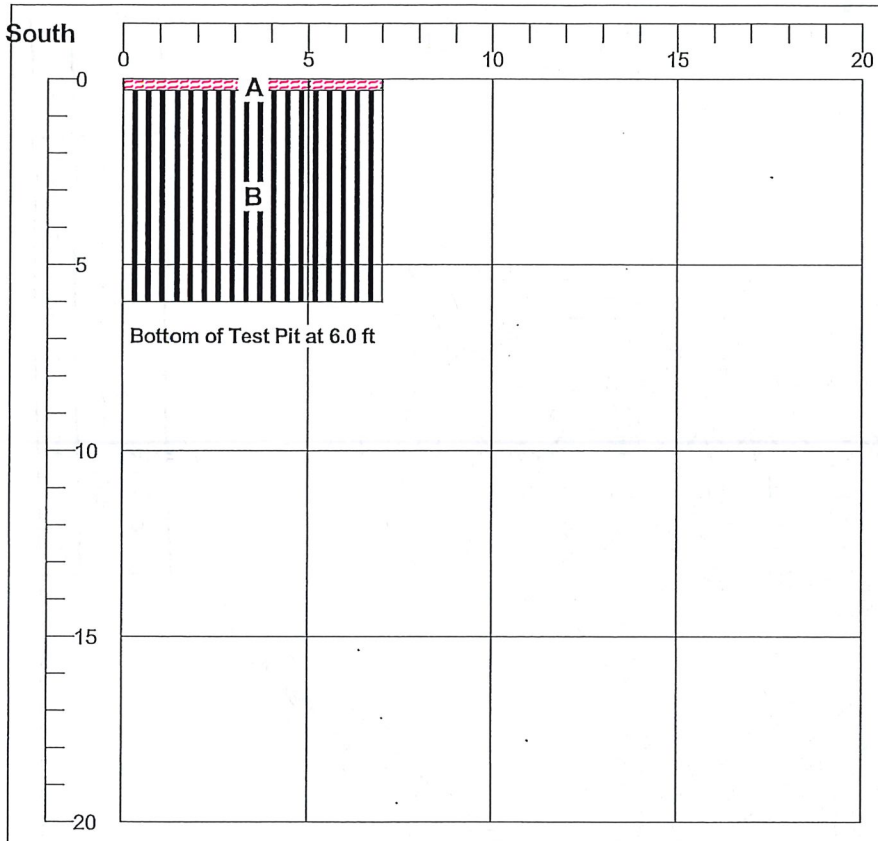
LOG OF TEST PIT TP-7

Golder Associates

Temp _____ °F Weather Clear
Equipment CAT 303GR
Elevation _____
Location _____

Engineer AGM
Contractor Mountain View
Datum Geodetic

Operator Ted
Date 11/4/2016
Job 1667207



SAMPLES		
NO.	DEPTH (ft)	MOISTURE (%)

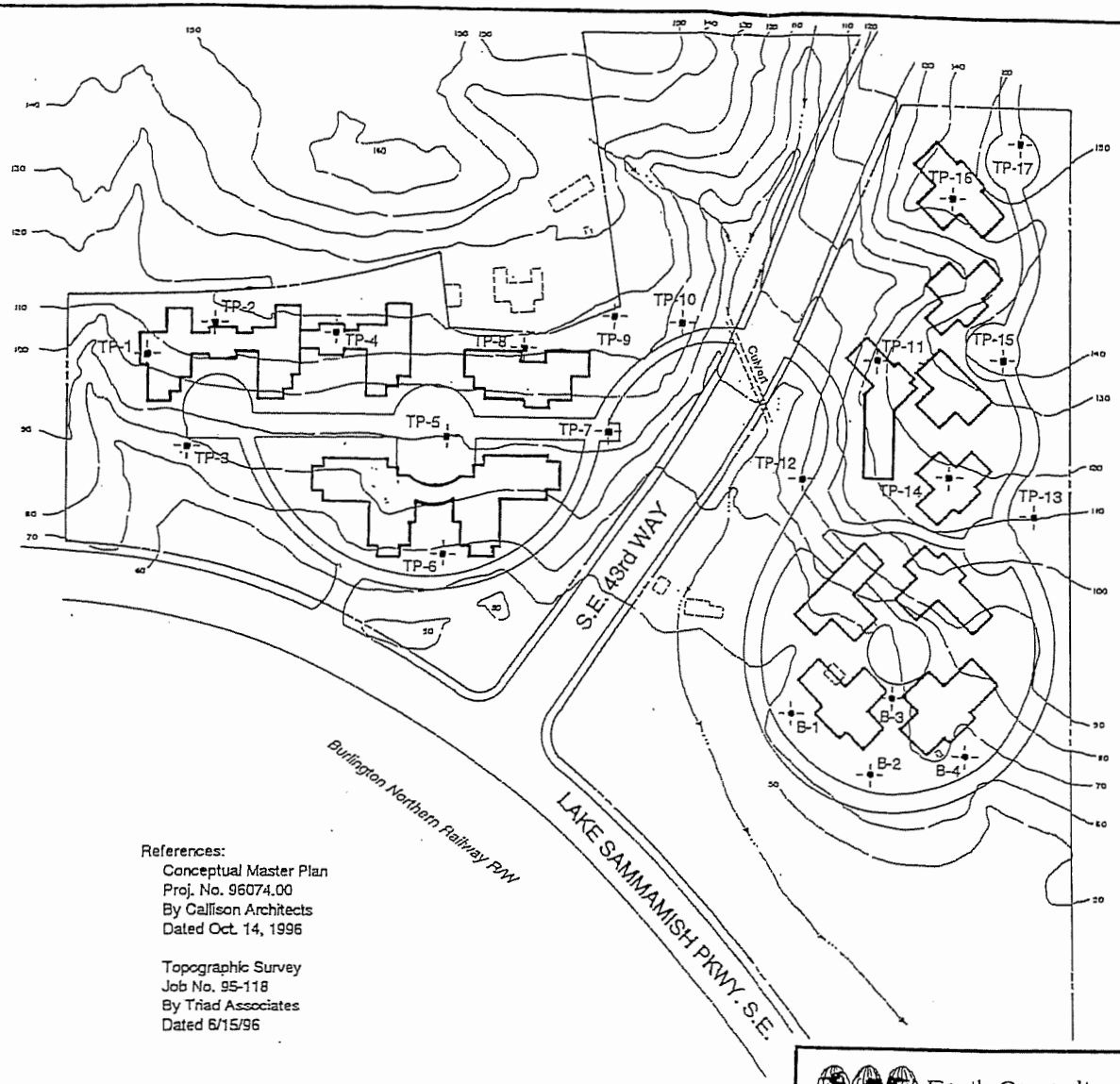
LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

A 0.0 - 0.3 ft: TOPSOIL

B 0.3 - 6.0 ft: MH, CLAYEY SILT, laminated, iron stained, roots, pale yellowish brown and medium gray, firm

TIME	DEPTH OF HOLE (ft)	DEPTH TO W/L (ft)	DEPTH TO SEEPAGE (ft)

SPECIAL NOTES:



N

Approximate Scale

0 75 150 300ft.

LEGEND

B-1 Approximate Location of ECI Boring, Proj. No. E-4718-4, Nov. 1996

TP-1 Approximate Location of ECI Test Pit, Proj. No. E-4718-4, Nov. 1996

Preliminary Building Location

Existing Building

References:

Conceptual Master Plan
Proj. No. 96074.00
By Callison Architects
Dated Oct. 14, 1996

Topographic Survey
Job No. 95-118
By Triad Associates
Dated 6/15/96

Earth Consultants Inc.
Geotechnical Engineers, Geologists & Environmental Services

Boring and Test Pit Location Plan
Proposed Mallard Bay
King County, Washington

Proj No. 4718-4	Drwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate 2

APPENDIX A

FIELD EXPLORATION

E-4718-4

Our field exploration was performed on November 21 and 25, 1996. Subsurface conditions at the site were explored by drilling four borings and excavating seventeen test pits. The borings were drilled with a truck mounted, hollow stem auger drill rig. The borings were extended to depths of eleven and one-half (11.5) to sixteen and one-half (16.5) feet below the existing grades. The test pits were excavated to depths ranging from eight (8) to eighteen (18) feet below the existing grades.

Approximate boring and test pit locations were determined by pacing from existing landmarks. The locations of the test pits should be considered accurate only to the degree implied by the method used. These approximate locations are shown on the Boring and Test Pit Location Plan, Plate 2.

The field exploration was continuously monitored by an engineer who classified the soils encountered and maintained a log of each boring and test pit, obtained representative samples, and observed pertinent site features.

In each boring, Standard Penetration Tests (SPT) were performed at selected intervals in general accordance with ASTM Test Designation D-1586. The split spoon samples were driven with a one hundred forty (140) pound hammer freely falling thirty (30) inches. The number of blows required to drive the last twelve (12) inches of penetration are called the "N-value". This value helps to characterize the site soils and is used in our engineering analyses.

Representative soil samples were placed in closed containers and returned for laboratory testing. All samples were visually classified in accordance with the Unified Soil Classification System which is presented on Plate A1, Legend.

Logs of the test pits are presented on Plates A2 through A12. The final logs represent our interpretations of the field logs and the results of the laboratory examination and tests of field samples. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
Coarse Grained Soils	Gravel And Gravelly Soils	Clean Gravels (little or no fines)		GW gw	Well-Graded Gravels, Gravel-Sand Mixtures, Little Or No Fines
				GP gp	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little Or No Fines
	More Than 50% Coarse Fraction Retained On No. 4 Sieve	Gravels With Fines (appreciable amount of fines)		GM gm	Silty Gravels, Gravel-Sand-Silt Mixtures
				GC gc	Clayey Gravels, Gravel-Sand-Clay Mixtures
	Sand And Sandy Soils	Clean Sand (little or no fines)		SW sw	Well-Graded Sands, Gravelly Sands, Little Or No Fines
				SP sp	Poorly-Graded Sands, Gravelly Sands, Little Or No Fines
More Than 50% Material Larger Than No. 200 Sieve Size	More Than 50% Coarse Fraction Passing No. 4 Sieve	Sands With Fines (appreciable amount of fines)		SM sm	Silty Sands, Sand-Silt Mixtures
				SC sc	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils	Silts And Clays	Liquid Limit Less Than 50		ML ml	Inorganic Silts & Very Fine Sands, Rock Flour, Silty-Clayey Fine Sands; Clayey Silts w/ Slight Plasticity
				CL cl	Inorganic Clays Of Low To Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
				OL ol	Organic Silts And Organic Silty Clays Of Low Plasticity
More Than 50% Material Smaller Than No. 200 Sieve Size	Silts And Clays	Liquid Limit Greater Than 50		MH mh	Inorganic Silts, Micaceous Or Diatomaceous Fine Sand Or Silty Soils
				CH ch	Inorganic Clays Of High Plasticity, Fat Clays.
				OH oh	Organic Clays Of Medium To High Plasticity, Organic Silts
Highly Organic Soils				PT pt	Peat, Humus, Swamp Soils With High Organic Contents

Topsoil		Humus And Duff Layer
Fill		Highly Variable Constituents

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

DUAL SYMBOLS are used to indicate borderline soil classification.

C	TORVANE READING, tsf
qu	PENETROMETER READING, tsf
W	MOISTURE, % dry weight
P	SAMPLER PUSHED
*	SAMPLE NOT RECOVERED
pcf	DRY DENSITY, lbs. per cubic ft.
LL	LIQUID LIMIT, %
PI	PLASTIC INDEX

I 2" O.D. SPLIT SPOON SAMPLER

II 2.4" I.D. RING OR SHELBY TUBE SAMPLER

WATER OBSERVATION WELL

▽ DEPTH OF ENCOUNTERED GROUNDWATER DURING EXCAVATION

▼ SUBSEQUENT GROUNDWATER LEVEL W/ DATE

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LEGEND

Proj. No. 4718-4	Date Dec '96	Plate A1

Boring Log

Project Name: Proposed Mallard Bay				Sheet 1 of 1
Job No. 4718-4	Logged by: RAC	Start Date: 11/21/96	Completion Date: 11/21/96	Boring No.: B-1
Drilling Contactor: Associated Drilling		Drilling Method: HSA		Sampling Method: SPT
Ground Surface Elevation: ±70'		Hole Completion: ☐ Monitoring Well ☐ Piezometer ☒ Abandoned, sealed with bentonite		

	W (%)	No. Blows Ft.	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions:
				1		ML	6" Topsoil and Sod FILL: Brown sandy SILT, loose, moist to wet
	26.5	12		2 3 4			-becomes medium dense, some organics
	26.3	24		5 6		ML	Gray sandy SILT, medium dense, moist to wet
LL=29 PL=25 PI=4	23.8	70		7 8 9			-some interbedded lenses of brown sandy silt, very dense
	25.5	41		10 11			-dense
	25.8	49		12 13 14			
	24.8	52		15 16			-very dense
							Boring terminated at 16.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with cuttings and bentonite.

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Boring Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A2

BL 47184 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Boring Log

Project Name: Proposed Mallard Bay					Sheet 1 of 1
Job No. 4718-4	Logged by: RAC	Start Date: 11/21/96	Completion Date: 11/21/96	Boring No.: B-2	
Drilling Contactor: Associated Drilling		Drilling Method: HSA		Sampling Method: SPT	
Ground Surface Elevation: ±70'		Hole Completion: ☐ Monitoring Well ☐ Piezometer ☒ Abandoned, sealed with bentonite			

W (%)	No. Blows Ft.	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions:
			1		SM	6" Topsoil and Sod FILL: Brown silty fine to coarse SAND with gravel, loose, moist to wet
			2			
23.5	14		3		ML	Gray sandy SILT, medium dense, moist to wet, mottled
			4			
			5			
26.7	16		6			
			7			
26.6	20		8			
			9			
			10			
28.3	24		11			
						Boring terminated at 11.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with cuttings and bentonite.

Earth Consultants Inc.
Geotechnical Engineers, Geologists & Environmental Scientists

Boring Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A3

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

/11/96
BL 4718.

Boring Log

Project Name: Proposed Mallard Bay				Sheet 1 of 1
Job No. 4718-4	Logged by: RAC	Start Date: 11/21/96	Completion Date: 11/21/96	Boring No.: B-3
Drilling Contactor: Associated Drilling		Drilling Method: HSA		Sampling Method: SPT
Ground Surface Elevation: ±70'		Hole Completion: ☐ Monitoring Well ☐ Piezometer ☒ Abandoned, sealed with bentonite		

W (%)	No. Blows Ft.	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions:
			1		ML	6" Topsoil and Sod FILL: Brown to gray sandy SILT, loose, wet to saturated, trace gravel and organics
			2			
26.0	17		3		ML	Gray sandy SILT, loose to medium dense, moist to wet, mottled
			4			
			5			
23.5	9		6			
			7			
39.9	11		8			-becomes medium dense
			9			
			10			
42.6	12		11			
						Boring terminated at 11.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with cuttings and bentonite.

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Boring Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A4

BL 47184 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Boring Log

Project Name: Proposed Mallard Bay					Sheet 1 of 1
Job No. 4718-4	Logged by: RAC	Start Date: 11/21/96	Completion Date: 11/21/96	Boring No.: B-4	
Drilling Contactor: Associated Drilling		Drilling Method: HSA		Sampling Method: SPT	
Ground Surface Elevation: ±70'		Hole Completion: ☐ Monitoring Well ☐ Piezometer ☒ Abandoned, sealed with bentonite			

W (%)	No. Blows FL	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions:
					ML	6" Topsoil and Sod FILL: Brown to black sandy SILT, loose, wet to saturated, some silty sand, trace organics
25.4	11		1–4			
			5		SM	Brown silty fine to medium SAND with gravel, loose to medium dense, wet, trace gravel
14.9	10		6–7			
14.7	6		8–9			-increasing gravel, saturated
			10		ML	Brown to gray sandy SILT, medium dense, wet, mottled, groundwater seepage encountered at 10'
29.2	14		11–12			
21.1	23		13			
			14			Boring terminated at 14.0 feet below existing grade. Groundwater seepage encountered at 10.0 feet during drilling. Boring backfilled with cutting and bentonite.

Earth Consultants Inc.
Geotechnical Engineers, Geologists & Environmental Scientists

Boring Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A5

BL 47184 ./11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-1
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±104'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
				SM	Dark brown silty SAND, loose, moist
		1		SM	Brown silty SAND with gravel
20.2		2			
		3		ML	Brown sandy SILT, medium dense, moist
32.0		4		SM	Brown silty SAND with gravel, dense, moist
11.5		5		SM	Brown silty SAND, medium dense, moist
		6			
15.6		7			
		8			
		9			
		10			
		11			Test pit terminated at 11.0 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A6

TPL 47184 12/11/96

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-2
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±118'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 8"
				SM	Dark brown silty SAND, loose, moist
		1		SM	Brown silty SAND with gravel, medium dense, moist
18.5		2			
		3		SM	Brown silty SAND, medium dense, moist
10.9				ML	Brown sandy SILT, medium dense, moist
		4		SM/ML	Interbedded layers of brown sandy SILT and silty SAND, medium dense, moist
24.2		5			
		6			
		7			
18.1		8			
		9			
		10			
20.7		11		ML	Brown SILT, dense, moist
		12			
25.9					Test pit terminated at 12.5 feet below existing grade. No groundwater encountered during excavation.

12/11/96

TPL 471.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A7

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay				Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-3	
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±78'	
Notes:				

	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 8"
					SM	Brown silty SAND, loose, moist
			1		ML	Brown SILT with sand, loose, wet
			2			
			3			-becomes medium dense and moist
LL=34 PL=29 PI=5	26.6		4			
			5			
			6			
	28.6		7			
			8		ML	Gray SILT, very dense, moist
			9			
						Test pit terminated at 9.5 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A8

TPL 47184 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-4
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±118'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
				SM	Dark brown silty SAND
		1		SM	Brown silty SAND, medium dense
24.5		2		ML	Brown SILT with sand, medium dense, moist
		3			
36.3		4			
19.1		5			-becomes very dense
		6			
		7			
		8			
		9			
26.6		10		ML	Gray SILT, very dense, moist
		11			
30.0		12			
		13			Test pit terminated at 13.0 feet below existing grade. No groundwater encountered during excavation.

Earth Consultants Inc. Geotechnical Engineers, Geologists & Environmental Scientists	Test Pit Log Proposed Mallard Bay King County, Washington				
Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A9

TPL 4718 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-5
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±90'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 12"
				SM	Dark brown silty SAND, loose, moist
		1		SM	Reddish brown silty SAND, loose, moist
		2		ML	Brown sandy SILT with occasional lenses of silty SAND, medium dense, moist to wet
		3			-groundwater seepage encountered at 3.5' to 4.5'
16.1		4			
		5		SM	Brown silty SAND, dense, moist
11.0		6			
		7			
		8			
		9			Test pit terminated at 9.0 feet below existing grade. Slight groundwater seepage encountered at 3.5 to 4.5 feet during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A10

TPL 4718A 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-6
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±70'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 8"
				SM	Dark brown silty SAND, loose, moist
		1		ML	Brown SILT, medium dense, moist
		2			
		3			
		4			
		5			
		6		ML	Gray sandy SILT, dense, moist
		7			
		8			Test pit terminated at 8.0 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A11

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

2/11/96 TPL 4715

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-7
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±95'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 8"
		1		SM	Dark brown silty SAND, loose, moist
				SP-SM	Brown poorly graded SAND with silt, loose, wet -groundwater seepage encountered 1' to 2'
24.6		2		ML	Brown with rust and gray streaks, SILT with sand, dense, moist
22.0		4			
25.3		7			
		8		ML	Gray SILT, very dense, moist
		11			Test pit terminated at 11.0 feet below existing grade. Moderate groundwater seepage encountered at 1.0 to 2.0 feet during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A12

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

TPL 47184 12/11/96

Test Pit Log

Project Name:			Sheet	of
Proposed Mallard Bay			1	1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-8	
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±110'	
Notes:				

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
				SM	TOPSOIL: Dark brown silty SAND, loose, moist
17.7		1		SM	Brown silty SAND, loose, moist
		2			
		3		SM	Brown silty SAND with gravel and occasional cobbles, medium dense, moist
		4			
9.1		5		SM	Gray well graded SAND with silt and trace gravel, meium dense, wet, groundwater seepage encountered at 5' to 6.5'
14.9		6			
		7		ML	Brown SILT, dense, moist
25.9		8			
		9		ML	Gray SILT with sand, dense, moist
25.5		10			
		11			
		12			
		13			
26.9		14			
		15			Test pit terminated at 15.0 feet below existing grade. Moderate groundwater seepage encountered at 5.0 to 6.5 feet during excavation.

2/11/96

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A13

4718 TPL

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-9
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±120'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
				SM	Dark brown silty SAND, loose, moist
8.2		1–3		SP-SM	Brown poorly graded SAND with silt, loose, moist
16.5		3–4		SM	Brown silty SAND, medium dense, moist
26.6		4–5		ML	Brown SILT, dense, moist
12.9		5–7		SP-SM	Brown poorly graded SAND with silt
		6–7		ML	Brown SILT, dense, moist
9.7		7–12		SP-SM	Brown poorly graded SAND with silt, dense
8.7		12–14			-increasing gravel
17.7		14–16		SM	Brown silty SAND with gravel, dense, moist
26.7		16–17		ML	Brown SILT, dense, moist
					Test pit terminated at 17.5 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A14

TPL 47184 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name:				Sheet	of
Proposed Mallard Bay				1	1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-10		
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±100'		
Notes:					

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
				SM	Dark brown silty SAND, loose, moist
6.2		1–3		SP	Gray poorly graded SAND with lenses of silty sand, loose to medium dense, moist
15.6		4–6		SM	Brown silty SAND, medium dense to dense, moist
9.7 13.9 15.6 25.5		7–16		ML	Brown sandy SILT, very dense, moist
26.3		17			Test pit terminated at 17.0 feet below existing grade. No groundwater encountered during excavation.

2/11/96

TPL 4716

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A15

Test Pit Log

Project Name: Proposed Mallard Bay				Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-11	
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±120'	
Notes:				

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
				ML	Brown sandy SILT, loose to medium dense, moist
25.5		1 2 3			
17.2		4 5 6		ML	Brown sandy SILT with gravel, very dense, moist
8.0		7 8			Tets pit terminated at 8.0 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A16

TPL 4718A 12/11/96

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-12
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±90'
Notes:			

Surface Conditions: Depth of Topsoil & Sod 6"

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
14.6		1		SM	Reddish brown silty SAND with gravel, loose, moist
		2		ML	Brown SILT with sand, dense, moist
16.1		3			
		4			
		5			
		6			
12.0		7			
		8			
		9			
					Test pit terminated at 9.5 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A17

TPL 4718 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-13
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±110'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
					Surface Conditions: Depth of Topsoil & Sod 12"
				SM	Dark brown silty SAND, loose, moist
		1		ML	Brown sandy SILT, medium dense, moist
		2			-groundwater seepage encountered at 2'
27.3		3			
		4			
		5			
17.2		6			
		7			
		8			
		9			-increasing sand content
		10			
		11			
25.7					Test pit terminated at 11.0 feet below existing grade. Slight groundwater seepage encountered at 2.0 feet during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A18

TPL 47184 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name:			Sheet	of
Proposed Mallard Bay			1	1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-14	
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±118'	

Notes:

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
12.4		1		SM	Dark brown silty SAND with occasional gravel, loose, moist
		2		SM	Brown silty SAND with gravel, dense, moist
7.1		3			
		4			
		5			
		6			
		7			
8.3		8			
		9			-rapid groundwater seepage encountered at 9'
					Test pit terminated at 9.0 feet below existing grade. Groundwater seepage encountered at 3.0 and 9.0 feet during excavation.

12/11/96

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A19

TPL 471.

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay				Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-15	
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±144'	
Notes:				

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
11.4		1–5		SM	Brown silty SAND with gravel, dense, moist
19.9		6–8		ML	Brown sandy SILT, very dense, moist -grades with gravel
		9			Test pit terminated at 9.0 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A20

TPL 47184 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Test Pit Log

Project Name: Proposed Mallard Bay				Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-16	
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±140'	
Notes:				

Surface Conditions: Depth of Topsoil & Sod 6"

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	
18.6		1		ML	Brown sandy SILT, loose, wet
8.4		2–6		SM	Brown silty SAND with gravel, dense, moist
5.1		6			
20.4		7–8		ML	Brown sandy SILT, very dense, moist
		9			Test pit terminated at 9.0 feet below existing grade. No groundwater encountered during excavation.

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Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No.	Dwn.	Date	Checked	Date	Plate
4718-4	GLS	Dec. '96	RAC	12/11/96	A21

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

TPL 4716 2/11/96

Test Pit Log

Project Name: Proposed Mallard Bay			Sheet 1 of 1
Job No. 4718-4	Logged by: KME	Date: 11/25/96	Test Pit No.: TP-17
Excavation Contactor: N.W. Excav.			Ground Surface Elevation: ±156'
Notes:			

W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of Topsoil & Sod 6"
22.8		1–4		ML	Brown sandy SILT with gravel, medium dense, moist
5.8		5–9		SM	Brown silty SAND with gravel, dense to very dense, moist
4.5					-increasing gravel with depth
					Test pit terminated at 9.5 feet below existing grade. No groundwater encountered during excavation.

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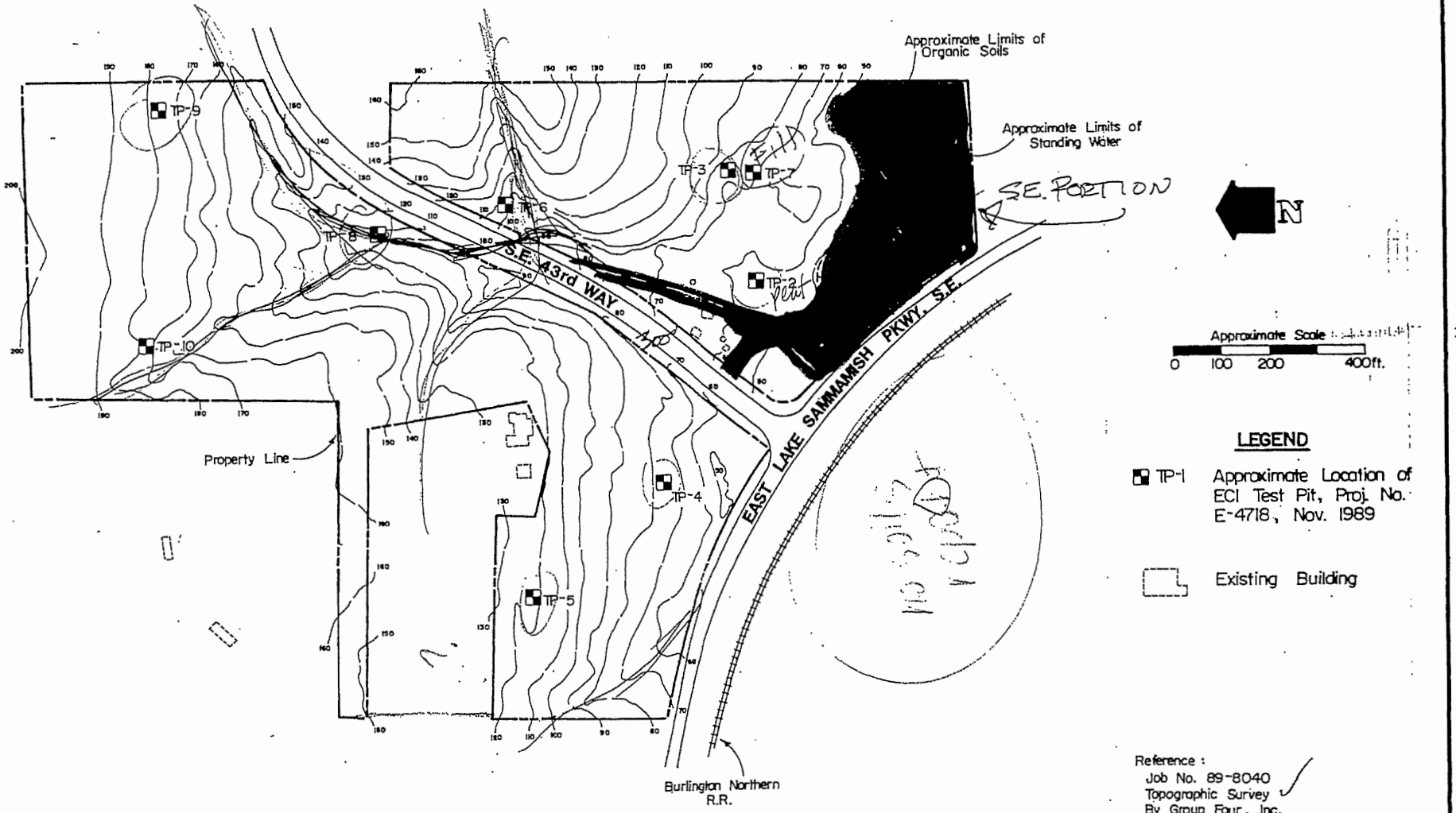
Test Pit Log
Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Dwn. GLS	Date Dec. '96	Checked RAC	Date 12/11/96	Plate A22

TPL 47184 12/11/96

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.


Approximate Limits of Organic Soils
Approximate Limits of Standing Water
SE. PORTION
N
TP-1
TP-2
TP-3
TP-4
TP-5
TP-6
TP-7
TP-8
TP-9
TP-10
S.E. 43rd WAY
EAST LAKE SAMMAMISH PKWY. S.E.
Property Line
Burlington Northern R.R.
Approximate Scale
0 100 200 400ft.
LEGEND
TP-1 Approximate Location of ECI Test Pit, Proj. No. E-4718, Nov. 1989
Existing Building
Reference :
Job No. 89-8040
Topographic Survey
By Group Four, Inc.
Dated 10/27/89
Earth Consultants Inc.
Geotechnical Engineers, Geologists & Environmental Scientists
Test Pit Location Plan
East Lake Sammamish Development - North
King County, Washington
Proj No. 4718
Drwn. GLS
Date Feb '90
Checked SD
Date 2/8/90
Plate 2

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
Coarse Grained Soils	Gravel And Gravelly Soils	Clean Gravels (little or no fines)		GW gw	Well-Graded Gravels, Gravel-Sand Mixtures, Little Or No Fines
				GP gp	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little Or No Fines
	More Than 50% Coarse Fraction Retained On No. 4 Sieve	Gravels With Fines (appreciable amount of fines)		GM gm	Silty Gravels, Gravel-Sand-Silt Mixtures
				GC gc	Clayey Gravels, Gravel-Sand-Clay Mixtures
More Than 50% Material Larger Than No. 200 Sieve Size	Sand And Sandy Soils	Clean Sand (little or no fines)		SW sw	Well-Graded Sands, Gravelly Sands, Little Or No Fines
				SP sp	Poorly-Graded Sands, Gravelly Sands, Little Or No Fines
	More Than 50% Coarse Fraction Passing No. 4 Sieve	Sands With Fines (appreciable amount of fines)		SM sm	Silty Sands, Sand-Silt Mixtures
				SC sc	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils	Silts And Clays	Liquid Limit Less Than 50		ML ml	Inorganic Silts & Very Fine Sands, Rock Flour, Silty-Clayey Fine Sands; Clayey Silts w/ Slight Plasticity
				CL cl	Inorganic Clays Of Low To Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
				OL ol	Organic Silts And Organic Silty Clays Of Low Plasticity
More Than 50% Material Smaller Than No. 200 Sieve Size	Silts And Clays	Liquid Limit Greater Than 50		MH mh	Inorganic Silts, Micaceous Or Diatomaceous Fine Sand Or Silty Soils
				CH ch	Inorganic Clays Of High Plasticity, Fat Clays
				OH oh	Organic Clays Of Medium To High Plasticity, Organic Silts
Highly Organic Soils				PT pt	Peat, Humus, Swamp Soils With High Organic Contents

Topsoil		Humus And Duff Layer
Fill		Highly Variable Constituents

The Discussion In The Text Of This Report Is Necessary For A Proper Understanding Of The Nature Of The Material Presented In The Attached Logs

Notes:
Dual symbols are used to indicate borderline soil classification. Upper case letter symbols designate sample classifications based upon laboratory testing; lower case letter symbols designate classifications not verified by laboratory testing.

- 2" O.D. SPLIT SPOON SAMPLER
- 2.4" I.D. RING SAMPLER OR SHELBY TUBE SAMPLER
- P SAMPLER PUSHED
- SAMPLE NOT RECOVERED
- WATER LEVEL (DATE)
- WATER OBSERVATION WELL

- C TORVANE READING, tsf
- qu PENETROMETER READING, tsf
- W MOISTURE, percent of dry weight
- pcf DRY DENSITY, pounds per cubic ft.
- LL LIQUID LIMIT, percent
- PI PLASTIC INDEX

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LEGEND

Proj. No. 4718 | Date Nov'89 | Plate 3

TEST PIT NO. 1

Logged By SD

Date 11-7-89 Elev. 42±

pt	Brown to black fiberous PEAT, saturated, loose	35	
sm	Gray silty SAND, saturated, medium dense -heavy groundwater seepage	◁	
gm	Grades to silty sandy GRAVEL, wet, medium dense	17	
	Test pit terminated at 8 feet below existing grade. Heavy groundwater seepage encountered at 5 feet during excavation.		

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TEST PIT LOGS

Proj. No. 4718	Drwn. GLS	Feb'90	Checked SD	Date 2-8-90	Plate 4

TEST PIT NO. 2

Logged By SD

Date 11-7-89 Elev. 59±

Depth (ft.)	USCS	Soil Description	W (%)
0		(Topsoil and sod)	
	sm	Mottled brown silty fine SAND, some gravel, wet, medium dense	20
		-minor sloughing	
		-grades to gray	33
5	pt	4" thick fiberous PEAT layer	
	gm	Gray silty sandy GRAVEL, wet, medium dense	11
10		Test pit terminated at 10 feet below existing grade. Groundwater seepage encountered at 5 feet during excavation.	
15			

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TEST PIT NO. 3

Logged By SD

Date 11-7-89 Elev. 75±

Depth (ft.)	USCS	Soil Description	W (%)	
0		(6" topsoil)		
	ml	Light brown/tan fine sandy SILT, moist, very stiff	27	qu=5.0 tsf
	sm	Tan silty very fine SAND, moist, dense to very dense	23	
5		-grades to gray at this elevation		
			22	
10		Test pit terminated at 10 feet below existing grade. No groundwater seepage encountered during excavation.		
15				

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TEST PIT LOGS

EAST LAKE SAMMAMISH DEVELOPMENT
KING COUNTY, WASHINGTON

Proj. No. 4718	Drwn. GLS	Nov'89	Checked SD	Date 11-21-89	Plate 5

TEST PIT NO. 4

Logged By SD

Date 11-7-89 Elev. 74±

Depth (ft.)	USCS	Soil Description	W (%)	
0	sm	(4" topsoil and sod) Brown silty SAND with some gravel, moist, dense	10	
5		-grades to very dense	7	
10		Test pit terminated at 8 feet below existing grade. No groundwater seepage encountered during excavation.		
15				

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TEST PIT NO. 5

Logged By SD

Date 11-7-89 Elev. 122±

0	ml	(6" topsoil) Tan SILT, moist, very hard	38	qu=5.0 tsf+
5	sm	Tan silty very fine SAND, moist, very dense	29	
		-very difficult to excavate	19	
10		Test pit terminated at 9.5 feet below existing grade. No groundwater seepage encountered during excavation.		
15				

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TEST PIT LOGS
EAST LAKE SAMMAMISH DEVELOPMENT
KING COUNTY, WASHINGTON

Proj. No. 4718	Drwn. GLS	Nov'89	Checked SD	Date 11-21-89	Plate 6

TEST PIT NO. 6

Logged By SD

Date 11-7-89 Elev. 99±

Depth (ft.)	USCS	Soil Description	W (%)	
0	sm	Tan silty fine SAND, moist, dense		
		-varved	17	
		-grades to very dense		
5		-thin layers of compressed organics	27	
		Test pit terminated at 5 feet below existing grade. No groundwater seepage encountered during excavation.		
10				
15				

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TEST PIT NO. 7

Logged By SD

Date 11-8-89 Elev. 74±

0		(Crushed rock)		
		~~Brown~~ silty SAND with gravel, moist, loose, "Fill"	19	
		-roots	18	
5			20	
	pt	SOD layer, roots		
10	ml	Tan SILT, moist, very hard	38	qu=5.0 tsf
		Test pit terminated at 11 feet below existing grade. No groundwater seepage encountered during excavation.		
15				

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TEST PIT LOGS
EAST LAKE SAMMAMISH DEVELOPMENT
KING COUNTY, WASHINGTON

Proj. No. 4718	Drwn. GLS	Nov'89	Checked SD	Date 11-21-89	Plate 7

TEST PIT NO. 8

Logged By SD

Date 11-8-89 Elev. 107±

Depth (ft.)	USCS	Soil Description	W (%)
0	sm	(6" topsoil) Brown silty SAND some gravel, moist, medium dense	16
		-grades to gray and dense	11
5		Test pit terminated at 4.5 feet below existing grade. No groundwater seepage encountered during excavation.	
10			
15			

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Logged By SD

TEST PIT NO. 9

Date 11-8-89 Elev. 177±

Depth (ft.)	USCS	Soil Description	W (%)
0	sm	(6" topsoil) Brown silty SAND, some gravel, moist, medium dense	16
5		Test pit terminated at 4 feet below existing grade. No groundwater seepage encountered during excavation.	
10			
15			

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TEST PIT LOGS
EAST LAKE SAMMAMISH DEVELOPMENT
KING COUNTY, WASHINGTON

Proj. No. 4718	Drwn. GLS	Nov'89	Checked SD	Date 11-21-89	Plate 8

TEST PIT NO. 10

Logged By SD

Date 11-8-89 Elev. 175±

Depth (ft.)	USCS	Soil Description	W (%)	
0		(6" topsoil)		
	sm	Brown silty SAND, some gravel and cobble, moist, medium dense	15	
		-grades to dense		
5		Test pit terminated at 5 feet below existing grade. No groundwater seepage encountered during excavation.		
10				
15				

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TEST PIT LOGS
EAST LAKE SAMMAMISH DEVELOPMENT
KING COUNTY, WASHINGTON

Proj. No. 4718	Drwn. GLS	Nov'89	Checked SD	Date 11-21-89	Plate 9

APPENDIX B
LABORATORY TEST RESULTS

ATTERBERG LIMITS

ASTM D 4318

PROJECT NAME: BURNSTEAD/MALLARD BAY/WA
PROJECT NUMBER: 1667207
SAMPLE ID: TP-3 / S-1 SAMPLE DEPTH: 3-3.5'
SAMPLE TYPE: GRAB

SAMPLE PREPARATION

Wet or Dry: Dry

Minus #40 Sieve: Yes

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			NATURAL MOISTURE
Number of Blows				16	23	31	
Weight of Wet Soil & Tare (gm)	32.70	32.50	26.70	44.30	39.70	44.40	36.50
Weight of Dry Soil & Tare (gm)	32.50	32.20	26.40	40.80	36.00	41.20	33.90
Weight of Tare (gm)	31.20	31.00	24.70	30.90	24.80	31.40	25.30
Weight of Water (gm)	0.20	0.30	0.30	3.50	3.70	3.20	2.60
Weight of Dry Soil (gm)	1.30	1.20	1.70	9.90	11.20	9.80	8.60
Water Content %	15.38	25.00	17.65	35.35	33.04	32.65	30.23

PLASTIC LIMIT (PL): 19

LIQUID LIMIT (LL): 33

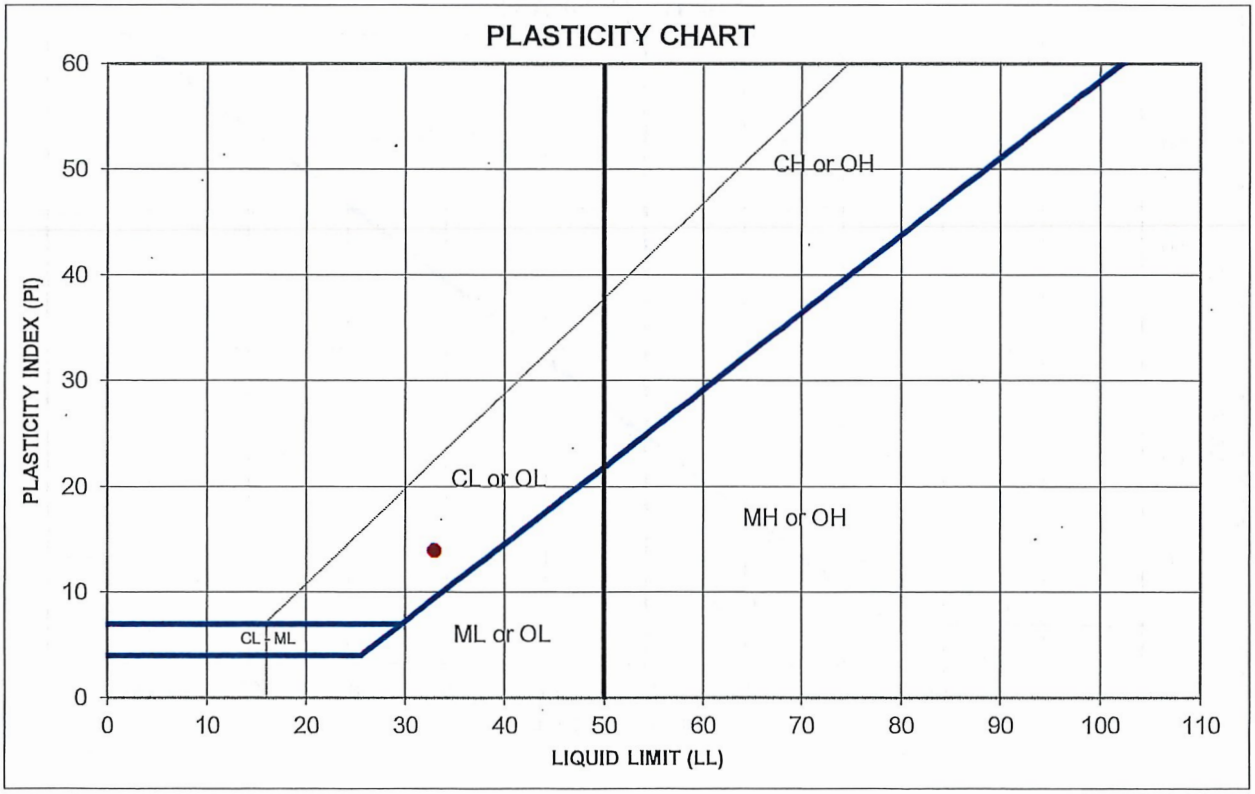
PLASTICITY INDEX (PI): 14

LIQUIDITY INDEX (LI): 0.78

NOTE:

DESCRIPTION: SILTY CLAY

USCS: CL



TECH	RBK
DATE	12/01/2016
CHECK	SRV
REVIEW	JGJ

ATTERBERG LIMITS

ASTM D 4318

PROJECT NAME: BURNSTEAD/MALLARD BAY/WA
PROJECT NUMBER: 1667207
SAMPLE ID: TP-4 / S-1 SAMPLE DEPTH: 2'
SAMPLE TYPE: GRAB

SAMPLE PREPARATION

Wet or Dry: Dry

Minus #40 Sieve: Yes

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			NATURAL MOISTURE
Number of Blows				17	21	29	
Weight of Wet Soil & Tare (gm)	33.10	27.70	34.30	48.00	43.90	43.10	34.10
Weight of Dry Soil & Tare (gm)	32.90	27.30	34.00	44.00	39.40	38.90	32.30
Weight of Tare (gm)	31.30	25.10	32.00	31.70	25.00	25.10	25.20
Weight of Water (gm)	0.20	0.40	0.30	4.00	4.50	4.20	1.80
Weight of Dry Soil (gm)	1.60	2.20	2.00	12.30	14.40	13.80	7.10
Water Content %	12.50	18.18	15.00	32.52	31.25	30.43	25.35

PLASTIC LIMIT (PL): 15

LIQUID LIMIT (LL): 31

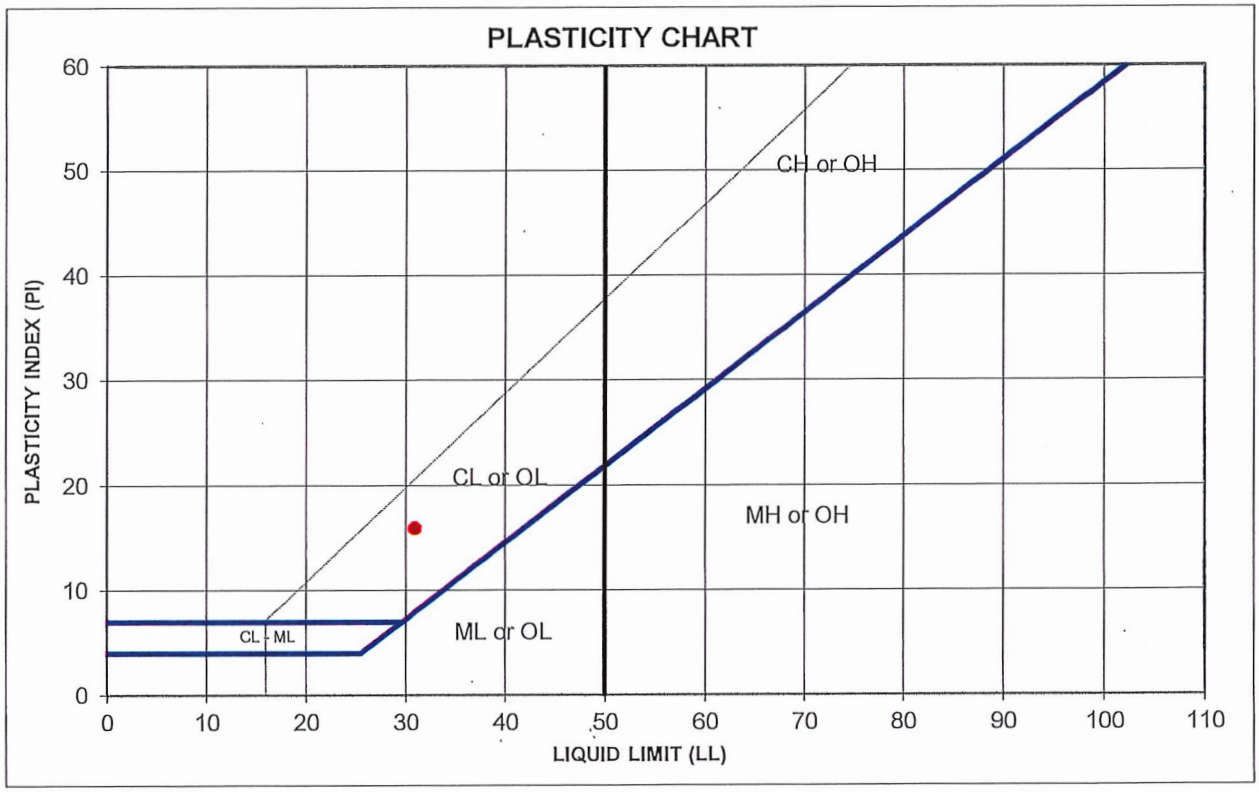
PLASTICITY INDEX (PI): 16

LIQUIDITY INDEX (LI): 0.63

NOTE:

DESCRIPTION: SILTY CLAY

USCS: CL



TECH	RBK
DATE	12/01/2016
CHECK	SRV
REVIEW	JGJ

ATTERBERG LIMITS

ASTM D 4318

PROJECT NAME: **BURNSTEAD/MALLARD BAY/WA**
PROJECT NUMBER: **1667207**
SAMPLE ID: **TP-7 / S-1** SAMPLE DEPTH: **1.5'**
SAMPLE TYPE: **GRAB**

SAMPLE PREPARATION

Wet or Dry: Dry — Minus #40 Sieve: Yes

	PLASTIC LIMIT DETERMINATION			LIQUID LIMIT DETERMINATION			NATURAL MOISTURE
Number of Blows				19	24	33	
Weight of Wet Soil & Tare (gm)	33.00	26.40	32.90	39.70	38.80	39.10	49.80
Weight of Dry Soil & Tare (gm)	32.80	26.20	32.70	34.60	34.10	34.40	45.30
Weight of Tare (gm)	31.90	25.40	31.70	25.20	25.10	24.90	31.70
Weight of Water (gm)	0.20	0.20	0.20	5.10	4.70	4.70	4.50
Weight of Dry Soil (gm)	0.90	0.80	1.00	9.40	9.00	9.50	13.60
Water Content %	22.22	25.00	20.00	54.26	52.22	49.47	33.09

PLASTIC LIMIT (PL): 22

LIQUID LIMIT (LL): 52

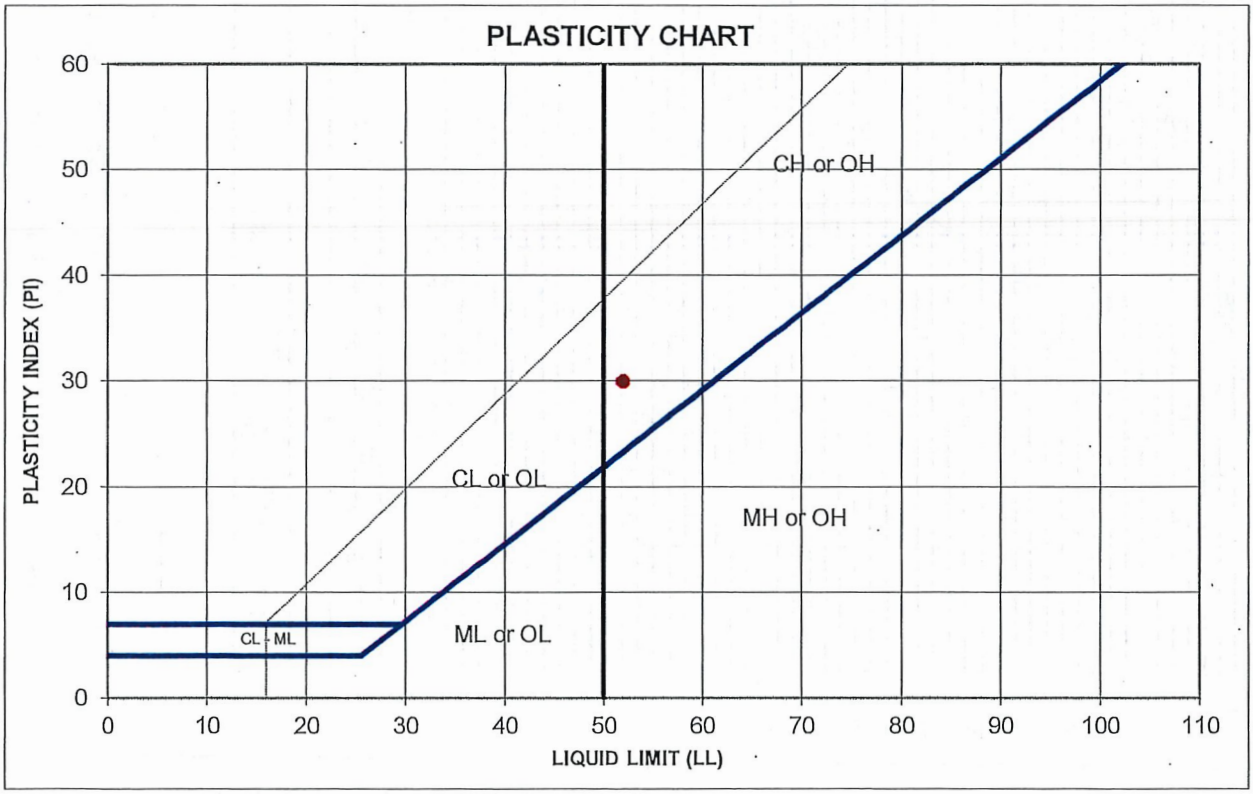
PLASTICITY INDEX (PI): 30

LIQUIDITY INDEX (LI): 0.36

NOTE:

DESCRIPTION: CLAY

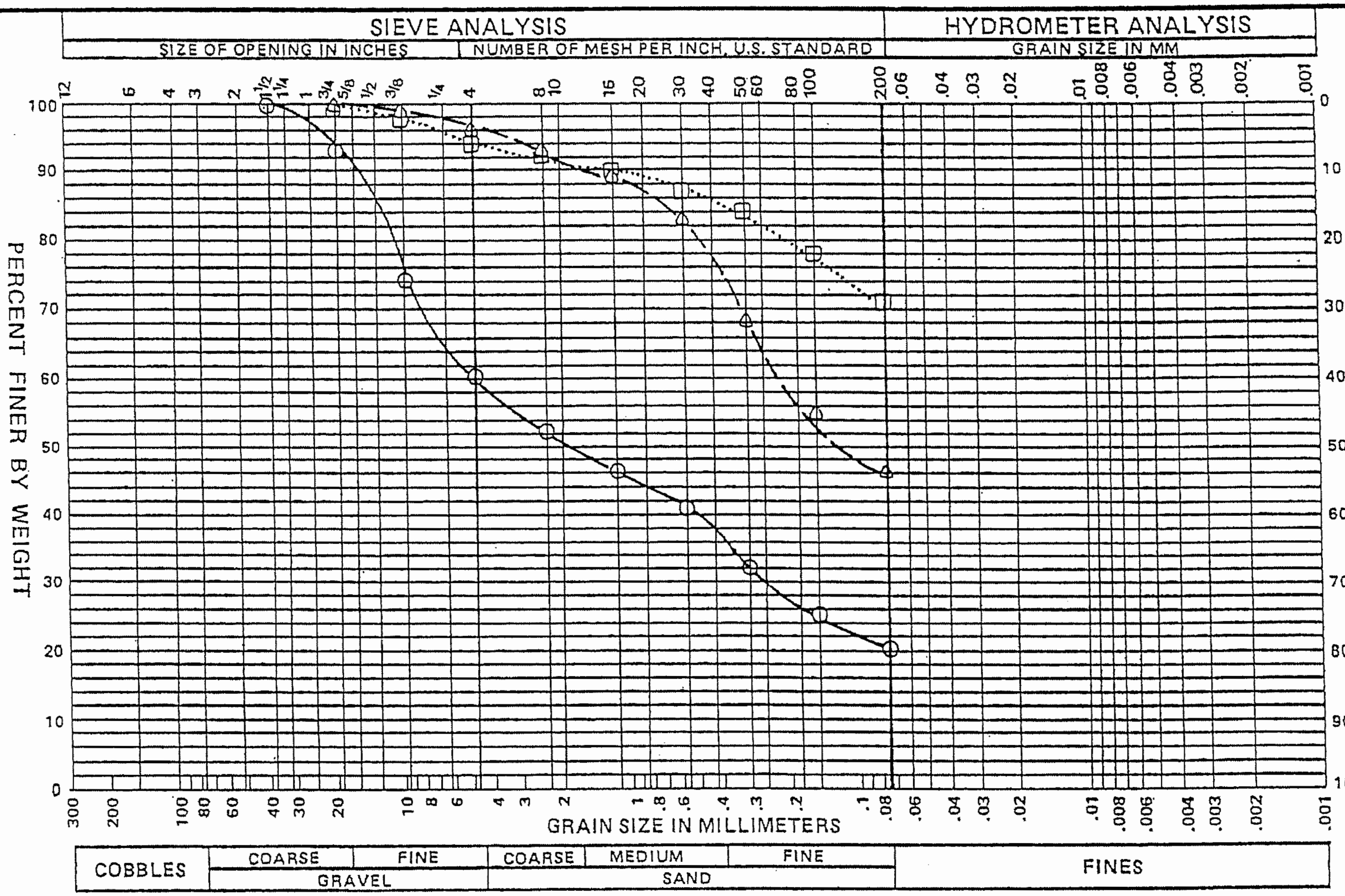
USCS: CH



TECH	RBK
DATE	12/01/2016
CHECK	SRV
REVIEW	JGJ

GRAIN SIZE ANALYSES

Proposed Mallard Bay
King County, Washington



KEY	Boring or Test Pit No.	DEPTH (ft.)	USCS	DESCRIPTION	Moisture Content (%)	LL	PL
○ ———	B-4	5	SM	Brown, silty sand with GRAVEL	14.9	--	--
△ — — —	TP-2	2	SM	Brown, silty sand	18.5	--	--
□	TP-7	2	ML	Brown, silt with sand	24.6	--	--

Earth Consultants Inc.
Geotechnical Engineers, Geologists & Environmental Scientists

Proj. No. 4718-4
Drwn. GLS
Date Dec '96
Checked RAC
Date 12/11/96
Plate B1

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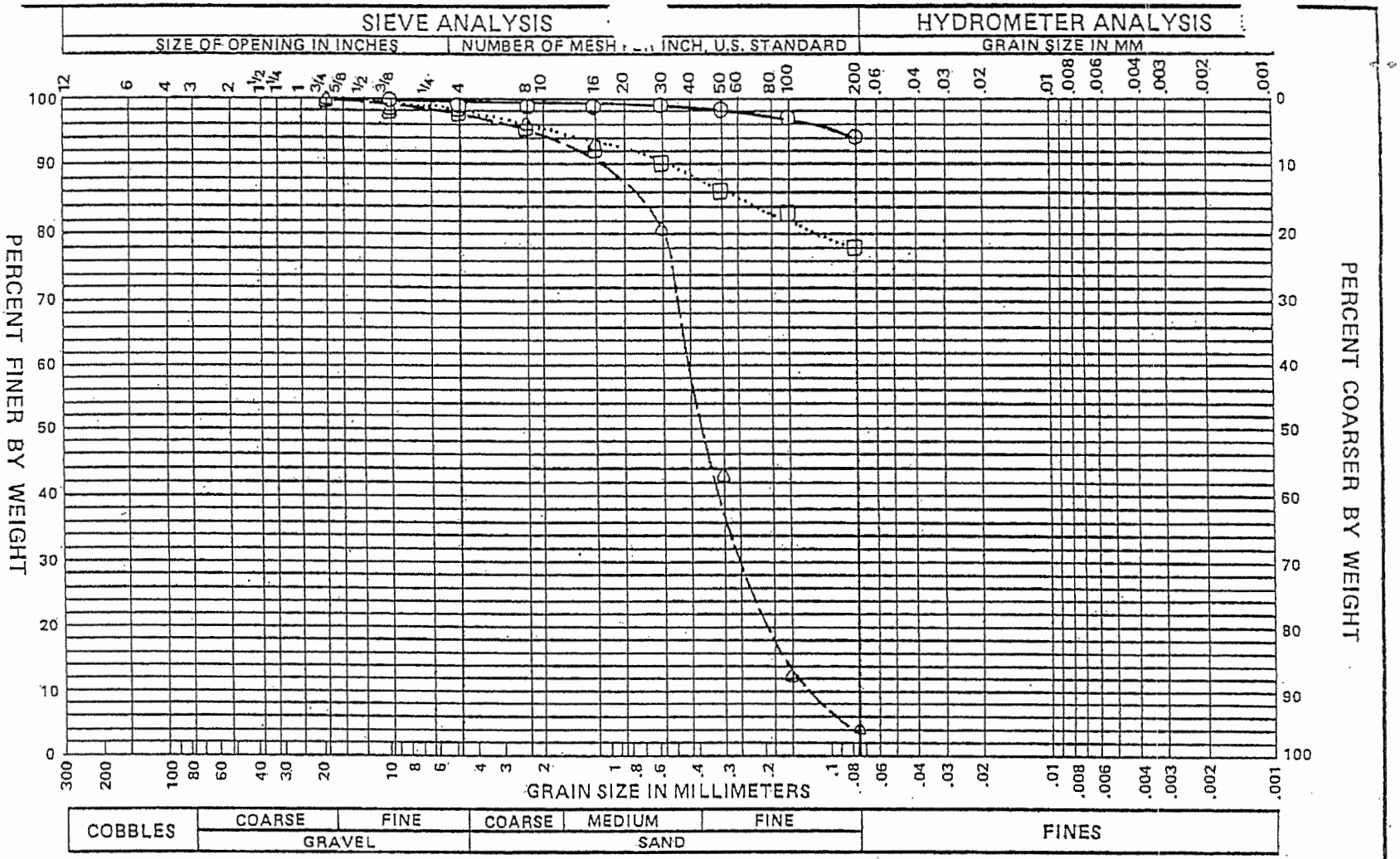
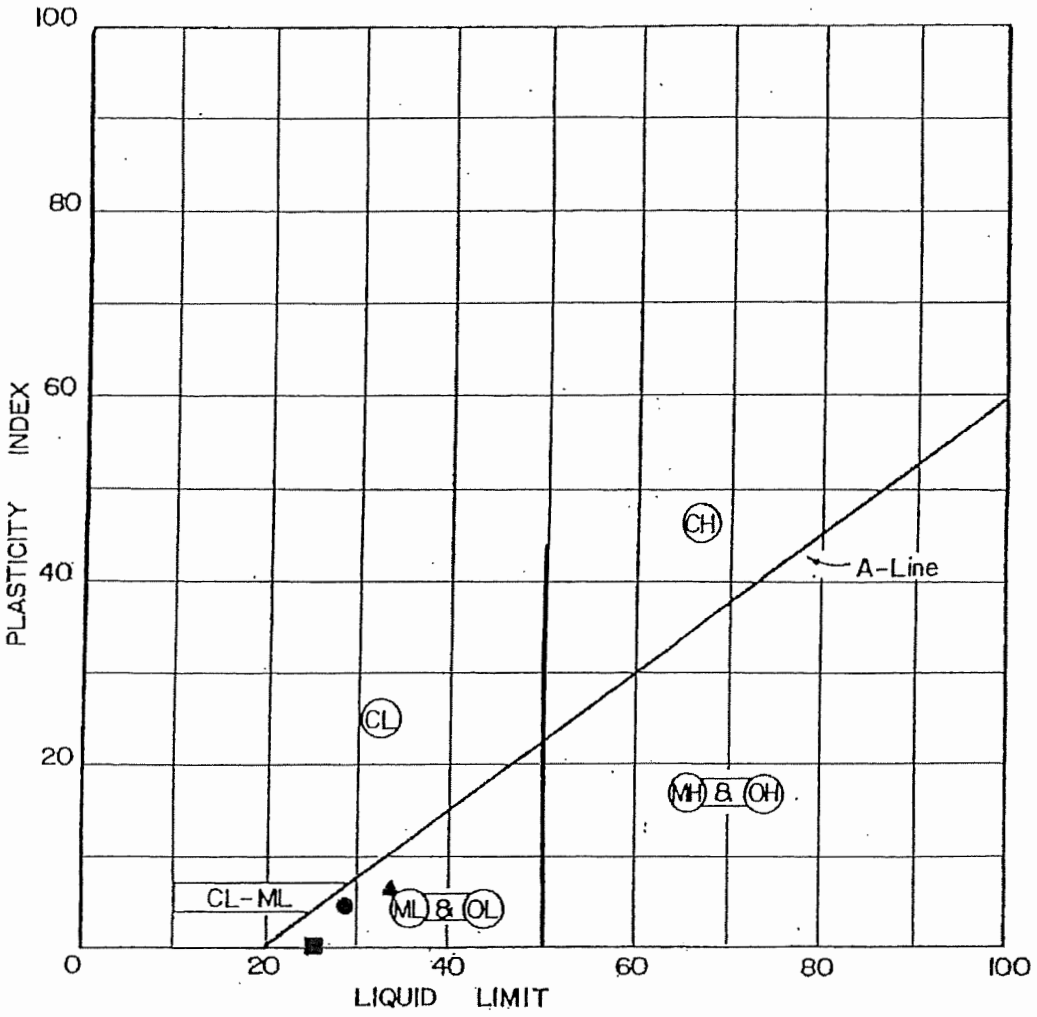
Geotechnical Engineers, Geologists & Environmental Scientists

Proj. No. 4718-4 | Drwn. GLS | Date Dec '96 | Checked RAC | Date 12/11/96 | Plate B2

GRAIN SIZE ANALYSES
Proposed Mallard Bay
King County, Washington



KEY	Boring or Test Pit No.	DEPTH (ft.)	USCS	DESCRIPTION	Moisture Content (%)	LL	PL
○ ———	TP-8	6.5	ML	Brown, silt	27.6	--	--
△ — — —	TP-10	2.5	SP	Gray, poorly graded sand	8.2	--	--
□ ·····	TP-12	4	ML	Brown, silt with sand	17.2	--	--



Key	Boring/ Test Pit	Depth (ft.)	Soil Classification	USCS	L.L.	P.L.	P.I.	Natural Water Content
●	B-1	5	Gray silt	ML	29	25	4	29.8
▲	TP-3	4	Brown silt	ML	34	29	5	33.4
■	TP-12	2	Brown silt	ML	25	25	0	26.2

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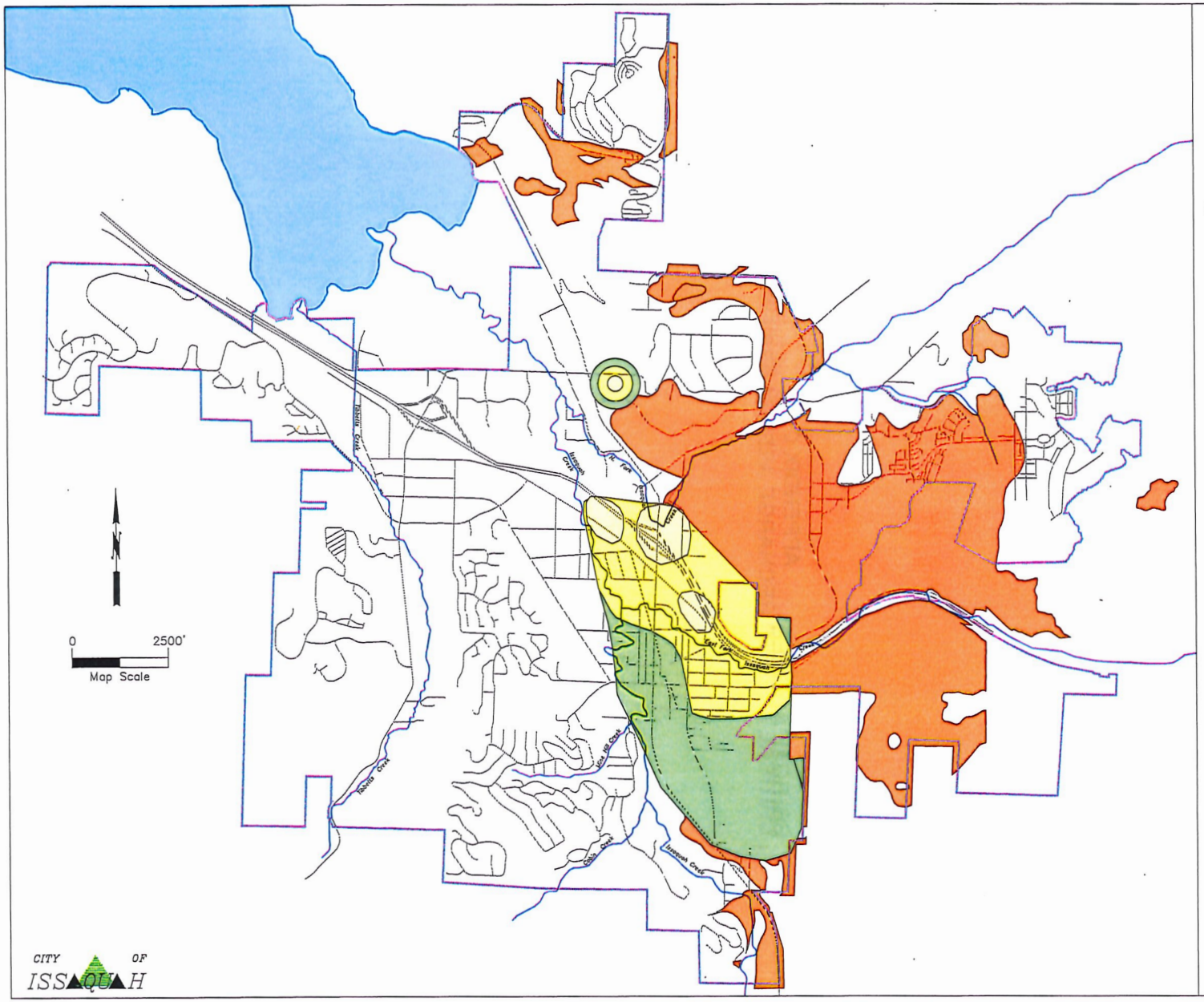
Geotechnical Engineers, Geologists & Environmental Scientists

Atterberg Limits Test Data

Proposed Mallard Bay
King County, Washington

Proj. No. 4718-4	Date Dec '96	Plate B3

APPENDIX C
CRITICAL AQUIFER RECHARGE AREA CLASSIFICATION MAP



CRITICAL AQUIFER RECHARGE AREA CLASSIFICATION MAP

LEGEND

CARA CLASSES

- Class 1 - 1 & 5 year Wellhead Capture Zone
- Class 2 - 10 year Wellhead Capture Zone
- Class 3 - High Aquifer Recharge Area

AB 5676
Exhibit A
Page A-66

Notes:

1) CARA Class 1 and Class 2 are based on wellhead capture zones that are documented in Lower Issaquah Valley Wellhead Protection Plan (Golder Associates, 1993) and Wellhead Protection Delineation for Overdale Well (Golder Associates, 1997).

2) CARA Class 3– High Aquifer Recharge Area is based on surficial geology and soil units have high to moderate susceptibility to contamination. Sources for recharge area mapping include: Geologic Map of the Issaquah 7.5' Quadrangle (Booth and Minard, 1992) for all areas except Issaquah Highlands; Report on Geotechnical Services, Draft Environmental Impact Statement for Proposed Grand Ridge Development (Geoengineers, 1995) for Issaquah Highlands; and King County Soil Survey (U.S. Soil Conservation Service, 1973) for all areas.

CITY OF ISSAQUAH

Exhibit C to Ordinance: CARA Map

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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